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DARTONFIELD GROUP—VISITORS' DAY

Those who wish to visit the Institute are requested to do so after making an appointment. No special days are set apart as Visitors' Days and the services of the technical officers can be availed of for discussion or demonstration only by prior appointment.

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Rubber Research Institute publications comprising Annual Reports, Quarterly Journals and occasional Bulletins and Advisory Circulars are available without charge to the Proprietors (resident in Ceylon), Superintendents and Local Agents of rubber estates in Ceylon over 30 acres in extent. Advisory Circulars and Smallholdings Folders in English or Sinhala will be available without charge to smallholders on application. Forms of application can be supplied on request.

It will be appreciated if subscribers will return any back publications which are of no use to them.

ADVISORY CIRCULARS

The undernoted Advisory Circulars may be obtained on application at 30 cents per copy. Future issues in the series will be sent free of charge to estates and smallholders registered for the receipt of our publications:—

(5) Straining box for latex (January, 1940).

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(64) Bark Rot and Canker of Hevea—Phytophthora Palmivora (Superseding Advisory Circular No. 54) (December, 1958).

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(66) Manuring of Rubber (Superseding Advisory Circulars No. 59 & 59A) (April, 1959).

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(70) Oidium Leaf Disease (Superseding Advisory Circular No. 43). *In preparation.*

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INVESTIGATIONS OF THE EFFECTS OF COPPER DUSTS USED TO CONTROL PHYTOPHTHORA LEAF DISEASE

PART I. COPPER CONTAMINATION OF LATEX AND SCRAPS

By

K. F. Heinisch, M. Nadarajah and M. T. Veerabangsa

It has been found that despite the prevention in the field of direct contamination of the latex by copper dusting the natural copper content of the rubber may increase, indicating that the copper may enter the tree either through the leaves or through the roots.

The panel scrap often shows a much higher copper content than the latex and it is suggested that this is caused by a higher content of phenol oxidase in the scrap, the enzyme being excreted from the bark tissue wounded by the tapping operation.

The contamination of rubber due to copper dusting is mainly a problem of the scrap grades, and it would appear that the use of skirt-type polythene rainguards covering the tapping panel, may considerably reduce the risk and degree of copper contamination. A high degree of contamination of commercial lower grade rubbers is mainly due to insufficient care in the field and to non-compliance with the recommendations for minimizing the risk of contamination. With the implementation of the recommended precautions and treatments no serious copper contamination should occur.

Introduction:

The fungus *Phytophthora palmivora* Butler, causes a leaf fall in Ceylon commencing shortly after the onset of the South West monsoon in May-June. The incidence of *Phytophthora* is favoured by frequent rains, mist, generally moist conditions and a drop in temperature to about 68°-78°F. The leaf disease caused by *Phytophthora palmivora* is also prevalent in South India, Burma, parts of Indonesia and parts of Central and South America.

Copper-based dusts were found to be the most effective and the most economical fungicide against this fungus. The dusts used in Ceylon are in the form of cuprous oxide or copper oxychloride containing 6% or 4% copper in the absence of a sticker, or 1% copper in the presence of a suitable sticker.

Dusting is normally carried out at the rate of 8-10 lb. per acre at intervals of about 5 days. A first round of dusting may be carried out after the onset of the regular monsoon showers. The complete dusting programme (second and subsequent rounds) are continued only if signs of a *Phytophthora* attack are found in a particular field. Fields which have been severely affected in previous years may be dusted in the beginning at the higher rate of 10 lb. or more per acre, per round. Dusting is carried out only when leaves are wet, as wet leaves retain considerably more dust. This condition normally occurs early in the morning until about 7 a.m. if there is dew, or immediately after a shower. Dusting on dry leaves is not very effective.

Our investigations of the effect of copper dusts were mainly concerned with the extent of the contamination of the latex and the scraps and with remedial steps for reducing the degree of copper contamination below the permissible limit of 8 p.p.m.

The effect of copper, even when present in very small amounts, in promoting the degradation of rubber has long been known. The literature contains a great number of references to this effect (1). It is known that not all copper compounds behave with the same potency in natural rubber. Some compounds of copper are less active than others and some are completely inactive in certain environments. KIRCHHOF (2) has stressed in 1927 that copper compounds soluble in rubber are much more deleterious than insoluble compounds. Copper salts may accordingly react with the fatty acids present in rubber to form copper soaps which are readily soluble in rubber and act as strong oxidation catalysts. VILLAIN (3) found on the basis of Geer oven and oxygen bomb tests that the deleterious activity of various copper-containing compounds may be roughly classified in the following order:—

Copper stearate, Copper resinate } most active

Copper sulphate, Copper chloride, Copper acetate } very active

Copper oxides, Copper powder } less active

Copper sulphides—least active.

There is evidence that the above salts act as catalysts increasing the rate of oxidation but not changing the nature of the oxidative reaction. The inorganic copper compounds show a relatively weak catalytic effect, cupric oxide being about 1/10th and copper sulphate about 1/5th as effective as copper stearate. In contrast the copper salts of weak organic acids are powerful pro-oxidants.

The permissible extent of the copper content in rubber is limited by the "Type Description of the Rubber Manufacturers' Association of New York", which fixes the maximum tolerance of copper at 8 p.p.m.

For a long time it had been considered that the copper present in biological material was largely incidental and had no definite function. However, later work established the universal distribution of copper in plant life. The copper content was found to be of the order of 0.1 to about 60 p.p.m., most of the copper being in the meristematic tissues and the biologically more active parts of the plants. It has been shown that copper plays an important role in the physiological processes and that several enzymes playing vital functions in plant growth contain copper as a functional group (4),(5).

Since the introduction of the dithiocarbamate reagent (6), a sufficiently sensitive method has been available for an accurate determination of traces of copper in rubber present on the average between 3-5 p.p.m. KIRCHHOF (7) and FLINT and RAMAGE (8) have been the first to determine accurate values of the natural copper content of solid rubber and latex respectively.

VAN DER BIE (9) mentioned clonal variations of the copper content and has drawn attention to the influence of different soil types on the natural copper content of the rubber.

BEAUFILS (10) and COMPAGNON and BEAUFILS (11) have claimed that copper has an important role in the rubber trees' absorption of potassium from the soil and that the concentrations of copper and potassium in the latex are highly

correlated. Van Der Bie (9) established a positive correlation between copper content and water extract and mentioned that the copper is present in latex as a colloidal complex, probably in combination with the enzymes of the latex. Beaufils (12) mentioned also that certain clones are liable to be richer in copper than others but adds that such variations are much less important than those which stem from seasonal factors. De Jonge (13) noticed that the application of the yield stimulant "Stimulex" (containing no copper) to a 3 inch strip of lightly scraped bark below the tapping cut, as well as the application of copper sulphate in powder form to holes bored into the tree, caused an increase in the copper content of the latex. Bolle-Jones (14) concluded that the rubber tree has a high requirement for copper, but that there is no evidence for assuming that copper plays a major role in rubber synthesis.

Risdon (16) on the basis of a small-scale survey of Ceylon rubber came to the conclusion that little, if any, of the higher grades of smoked sheet and crepe would be expected to show copper contents above 8 p.p.m. However, certain selected pieces from samples of the lowest grades of sheet did show copper contents above 8 p.p.m., although this was by no means normal.

Even though the use of copper-containing sprays or dusts for controlling leaf fall due to *Phytophthora palmivora* are not new techniques, little serious attempt appears to have been made prior to 1955 to investigate the copper contamination of the rubber. Petch (15) had reported a brief experiment involving the use of Bordeaux Mixture fungicide and concluded that as the relevant samples of the product were not obviously deteriorated on visual inspection, further comments on the effect of Bordeaux Mixture would have to be reserved until a later date.

Risdon (17) carried out experiments on the contamination of natural rubber by fungicidal dusts containing copper. Dusting with "Blendox" (6% Cu) was carried out every two weeks with sample collection at every tapping. At the same time an adjacent area, into which dust may have drifted, has been sampled for a period of about a year. A summary of the copper content of nearly 1,700 samples of latex films, latex crepes, scraps and scrap crepe examined is reproduced in Table 1.

TABLE 1

Dusting Experiments with Copper-containing Fungicides 1955-56
Summarizing Table

Sample Type	Field Treatment	No. of samples	% samples above 7.9 p.p.m.	Highest value p.p.m.
Latex Unprocessed t.s. Film	Copper Dusted Areas	134	18	30
—do—	Drift Dusted Areas	86	0	7
Latex Processed as				
(*a*) Blanket Crepe	Copper Dusted Areas	239	1	13
—do—	Drift Dusted Areas	58	0	4
—do—	Control Areas	68	0	3
(*b*) White Fraction Crepe	Copper Dusted Areas	78	1	39
—do—	Drift Dusted Areas	34	0	4
Unprocessed Scrap Samples	Copper Dusted Areas	268	22	67
—do—	Drift Dusted Areas	172	8	11
Scrap Processed as Blanket Crepe	Copper Dusted Areas	353	9	179 (100)
—do—	Drift Dusted Areas	99	0	7
—do—	Control Areas	93	0	7

The data indicate that some degree of contamination is liable to occur when copper-containing fungicidal dusts are used in areas of rubber in tapping.

To avoid as far as possible any copper contamination as a result of dusting, several precautions have been recommended by the Rubber Research Institute of Ceylon (18).

The implementation of these recommendations may have been responsible for the reduced extent of copper contamination of samples collected from commercial estates in 1957, (19) as reproduced in Table 2.

TABLE 2.

Copper Contamination of Rubber Samples from Commercial Estates 1957

Cu in p.p.m.

Sample Type	No. of Samples	Mean	% Samples above 7.9 p.p.m.
Latex Rubbers (Dusted Areas)	46	0.9	0
Latex Rubbers (Control Areas)	19	1.0	0
Scrap Crepes (Dusted Areas)	64	3.5	3
Scrap Crepes (Control Areas)	23	2.3	0

The risk of contamination may be overcome or reduced by the use of effective protective covers, such as polythene rainguards (20) over the tapping panel and the cups. On the assumption that the most important factor of contamination is the washing by rain of the copper from the tree into the scraps, the use of the rainguards designed by the Ceylon Institute of Scientific and Industrial Research (21) should prevent this.

EXPERIMENTAL:

Properties of Dusts used in the Experiments.

The commercial copper dusts used in the experiments were: (1) "Blendox", a fungicidal dust containing 6% copper based on copper oxychloride, the balance being a high quality inert filler. (2) "Ciba C 115", a blended fungicidal dust containing 1% copper based on copper oxychloride. It has in addition, incorporated into it, a sticker which enables the dust to be retained more firmly on the leaf.

The sticking power of the dusts was investigated in laboratory experiments as follows:—A mature leaf of *Hevea brasiliensis* from a previously undusted area was dipped in water to moisten it and dusted on both its sides with copper dust. The leaf was dried at room temperature for half an hour and soaked in 200 ml. of water, this process being repeated 5 times.

Two procedures were adopted:—In procedure A, the period of soaking was 2 minutes, there was no stirring and the whole leaf was soaked. In procedure B, the period of soaking was 5 minutes, there was slight mechanical stirring of the solution during soaking and the leaf was cut into six pieces. The copper remaining on the leaves after soaking is expressed as a percentage of the total copper dusted on it, and the values are given in Table 3.

TABLE 3

Sticking Properties of Copper Dusts
Cu in % of total copper

Treatment	Procedure A		Procedure B	
	Ciba C 115	Blendox	Ciba C 115	Blendox
After dusting ...	100%	100%	100%	100%
1st soaking ...	94	44	67	45
2nd soaking ...	93	41	65	33
3rd soaking ...	93	40	64	30
4th soaking ...	93	39	63	28
5th soaking ...	93	38	62	28

The results show that the "Ciba" dust has better sticking properties than "Blendox".

To find the solubility of the copper dusts in water, one grm. of the dust was stirred in 100 ml. of water for 10 minutes, kept for 24 hours, filtered through sintered glass crucibles, and the copper content of the solution determined.

The results in Table 4 show that a much lower amount of copper goes into solution from "Blendox" than from "Ciba C 115", although the former contains more copper.

TABLE 4

Solubility of the Dusts in Water as a Percentage of Original Copper

Water	Blendox 6%	Ciba 1%
Distilled water ...	0.3%	7.0%
Tap water ...	0.3%	5.3%
Rain water ...	0.2%	6.3%
CO_2-containing water ...	0.7%	7.9%

Natural Copper Content of Rubber:

Latex as a biological fluid shows a variation in its composition. It is not yet possible to differentiate principally between fundamental constituents of the fresh latex and incidental constituents which are dependent on physiological and climatic influences. For clonal latices figures of up to 15 p.p.m. copper have been found. Generally, about 70% of this copper is in the serum and 30% in the rubber. The copper present in fresh latex is to a great extent soluble in dilute acids and is removed with the serum, so that rubber manufactured from latex with a high initial copper content has a low copper value. If, however, bacterial decomposition starts due to delayed coagulation or delayed milling the copper may be precipitated as an insoluble sulphide on the rubber particles, giving an increased copper content in the rubber. Some proteins contain sulphur in the form of -SH groups (cysteine) and -S-S- groups (cystine). The -SH groups, the presence of which in latex has been indentified (25), are liberated after denaturation (bacterial action, coagulation) and may readily be oxidised to sulphide.

To obtain a survey of the natural copper content of latex and rubber in Ceylon, some data have been collected and these are summarized in the Tables 5 to 10.

TABLE 5

Copper Content of Samples from Undusted Areas 1958-1960.
Cu in p.p.m.

Samples	No. of Samples	Mean	% Samples over 7.9 p.p.m.	Highest Value
Latex film ...	235	4.2	6	13.5
Shell scrap, unprocessed ...	257	3.6	2	11.7
Panel scrap, unprocessed ...	257	4.5	7	30.4
Latex crepe ...	4	1.0	0	1.1
Shell scrap crepe ...	140	2.4	0	7.2
Panel scrap crepe ...	139	3.4	3	21.0

Table 5 shows a summary of the copper content of rubber sampled at random regularly during the years 1958–1960 from a 26-acre area of clones Hil 28, PB 183, Nab 15 and RRIM 501, which has been excluded from any copper dusting during the whole sampling period. A break up of the figures into monthly averages over a 3-year period is reproduced in Table 6.

TABLE 6

Monthly Variation of Copper Content
Average of 3 years
Cu in p.p.m.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Latex film	5.0	—	3.2	4.4	4.3	4.9	6.1	10.0	7.4	—	4.3	5.4
Shell Scrap	—	—	2.9	3.5	3.7	4.3	3.9	6.4	4.6	3.7	—	—
Panel Scrap	—	—	3.6	4.8	5.1	4.5	4.9	6.9	5.1	4.5	—	—

Individual samples of panel scrap from undusted areas very often show a much higher copper content than the latex film, the increase being far beyond the limits of the analytical and sampling error. These discrepancies have been observed regularly since 1957 in our sampling. Initially it has been assumed that the increased copper content of panel scrap, compared with the latex film, might be due to occasional contamination with small bark particles having a higher copper content or by wind-borne contamination with fine dust particles containing copper.

This increase of copper content occurred, however, too regularly and has, moreover, also been observed on samples where the tapping panel has been completely sealed off with polythene rainguards for protection against any outside contamination. The samples were collected from a 9-year-old tree of clone PB 86 at regular tapping intervals every 2 days, utmost care being taken to remove any adhering bark fragments. For 10 samples, average copper values of 4.5 p.p.m. for latex and 12.0 p.p.m. for panel scrap have been obtained. Only in one sample had the panel scrap a lower copper content than the latex, the difference between latex and scrap varying from 1.2 to 17.1 p.p.m.

It might, therefore, be surmised that the higher copper content of the scraps is caused by a higher content of phenol oxidase (tyrosinase), a copper-containing enzyme present in latex (27). Phenol oxidase possesses the ability to catalyze the

aerobic oxidation of monohydric and o-dihydric phenols. It has been suggested (26) that this enzyme serves to form a protective coating over injured parts of plants. It is believed to be activated after an injury of the tissue and to oxidise phenolic bodies to quinones, which in turn combine with proteins to form the protective coating over the injured tissue. Assuming that the excretion of the enzyme from the wounded tissue proceeds rather slowly, the content of phenol oxidase may be expected to be considerably higher in the scraps remaining on the tapping cut, than in the latex.

The copper content of the latices of twenty *Hevea brasiliensis* clones and of one *Hevea benthamiana* clone over a period of 6 months (January, March-July 1961) is reproduced in Table 7. It may be seen from this table that the copper content of several clones is rather high just before wintering and becomes lower after wintering. Some of the clones, such as LCB 1320, PR 107, RRIC 52 and RRIC 86, do not however show this increase. There is a high variation between clones as well as between months.

TABLE 7

Copper Contents of Clonal Latices in p.p.m.

Clone	January	March	April	May	June	July	Mean
PB 186 ...	7.2	4.9	5.0	5.0	7.1	8.6	6.3
PB 86 (old) ...	6.8	5.2	4.3	3.3	5.1	3.7	4.7
PB 86 (young)	3.2	2.6	2.1	4.1	3.7	8.6	4.1
Nab 12 ...	9.4	2.2	1.6	3.4	7.2	8.4	5.4
Nab 15 ...	5.4	1.7	1.3	3.3	4.2	6.8	3.8
Nab 20 ...	4.1	1.5	2.0	7.8	6.0	5.7	4.5
RRIM 500 ...	6.2	3.8	3.2	3.1	6.6	10.1	5.5
RRIM 501 ...	8.5	4.2	2.2	4.4	6.2	7.3	5.5
Tjir 1 ...	6.0	4.5	5.5	5.3	6.8	7.2	5.9
Mil 3/2 ...	7.2	2.7	4.6	4.6	5.9	7.6	5.4
AVROS 255 ...	6.2	3.1	3.3	6.0	5.4	6.1	5.0
AVROS 352 ...	10.9	3.7	3.7	5.3	6.7	7.6	6.3
LCB 1320 ...	3.3	2.7	5.5	5.5	5.2	4.9	4.5
PR 107 ...	1.5	2.3	3.1	3.5	5.2	4.3	3.3
Wagga 6278 ...	4.7	4.1	1.7	3.1	3.5	3.9	3.5
Gl 1 ...	—	4.8	4.5	5.1	8.1	6.0	5.7
RRIC 5 ...	7.0	7.6	5.3	9.1	7.3	5.1	6.9
RRIC 7 ...	8.2	3.4	4.6	7.3	6.7	6.9	6.2
RRIC 52 ...	4.2	4.3	4.8	10.7	5.1	6.6	6.0
RRIC 86 ...	4.7	4.1	6.6	8.4	7.3	9.1	6.7
H. benthamiana	—	5.2	2.0	1.4	3.3	3.5	3.1
Mean ...	6.0	3.7	3.7	5.2	5.8	6.6	

Copper Content of Commercial Rubbers:

Tables 8 to 10 reproduce the copper content of commercial rubbers from 5 estates, sampled monthly during 1960/1961. Table 8 gives a break up into the different grades of all estates, while Tables 9 and 10 show a break up according to estates for latex crepes and scrap crepes respectively.

TABLE 8

Copper Content of Commercial Rubbers from 5 Estates 1960/61
Cu in p.p.m.

Grade	No. of Samples	Mean	% samples over 7.9 p.p.m.	Highest Value
Latex Crepe IX ...	43	1.8	0	4.9
„ „ I ...	175	1.4	0	6.6
„ „ IA ...	25	1.8	0	6.2
„ „ 2 ...	102	1.7	1	9.5
„ „ 3 ...	112	2.7	4	18.6
„ „ 4 ...	51	3.2	8	18.0
Scrap Crepe 1 ...	172	4.3	9	14.1
„ „ 2 ...	148	7.0	29	38.4
„ „ 3 ...	90	16.2	72	80.4

TABLE 9

Copper Content of Commercial Latex Crepe (combined grades) from 5 Estates 1960/61.
Cu in p.p.m.

Estate	No. of Samples	Mean	% samples over 7.9 p.p.m.	Highest Value
No. I ...	141	2.0	3	18.0
II ...	24	3.0	4	8.5
III ...	209	1.7	2	18.6
IV ...	126	2.1	0	6.7
V ...	8	3.3	0	5.1

TABLE 10

Copper Content of Commercial Scrap Crepe (combined grades) from 5 Estates 1960/61
Cu in p.p.m.

Estate	No. of Samples	Mean	% samples over 7.9 p.p.m.	Highest Value
No. I ...	71	4.7	18	17.8
II ...	6	6.4	33	14.1
III ...	210	11.0	48	80.4
IV ...	52	5.0	10	12.1
V ...	71	4.3	3	14.7

From the Tables 8-10 it appears that the average copper content of commercial rubbers during 1960/61 is somewhat higher than in 1957 (Table 2). There are insufficient data to indicate that the extent of contamination is influenced by climatic variation. There seems, however, to be some indication that the natural copper content of the rubber might increase due to assimilation of copper by the tree after several years of dusting.

The latex crepes give a rather normal picture showing only a small percentage of increase of copper content for the grades Nos. 3 and 4. As these grades are mainly manufactured from froth, precoagulum, lumps etc. it may be assumed that the increased copper content is mainly due to naturally present copper precipitated on the rubber particles, with perhaps some incidental contamination in the case of the extreme values. Scrap crepes, however, especially the grades Nos. 2 and 3 show a very high degree of contamination.

A break up according to estates reveals that estates Nos. IV and V have no contamination of latex crepes and the lowest degree of contamination of the scrap grades. There are not sufficient figures for estate No. II. Estate No. III has an alarmingly high copper content, mainly in the grades Nos. 2 and 3, most probably due to insufficient care in the field, and insufficient or no blending procedure in the factory. Crepe No. 3 (earth scrap) of this estate is also highly contaminated with soil.

In this connexion it is interesting to see from Table 11, which gives the highest values of copper in commercial rubbers for each month from July 1960 to June 1961, that there is no marked increase in copper content in July 1960 when dusting was still going on, or shortly after the 1960 dusting, but rather that the high values are scattered over all months. No. 1 latex crepes show on the contrary some increase between October 1960 and January 1961 and scrap grades between September 1960 and April 1961. Except in obvious cases of contamination with soil or copper-containing panel dressings, these figures would point more towards a physiological or a seasonal increase of the copper content rather than to a direct contamination due to dusting.

TABLE 11

Highest Copper Values of Commercial Rubbers
Cu in p.p.m.

Month	Latex Crepe 1X, 1 & 1A	Latex Crepe 2 & 3	Scrap Crepe 1 & 2	Scrap Crepe 3
July 1960	4.1	3.0	8.0	4.0
Aug. ,,	1.4	2.5	6.3	12.3
Sept. ,,	3.1	18.6	12.2	17.8
Oct. ,,	5.8	7.8	11.0	15.6
Nov. ,,	4.8	5.0	12.8	17.0
Dec. ,,	6.6	8.0	16.8	18.2
Jan. 1961	6.4	6.7	18.5	17.0
Feb. ,,	4.5	2.6	10.7	57.4
Mar. ,,	3.1	9.5	38.4	80.4
Apr. ,,	2.8	8.5	12.5	—
May ,,	2.8	3.4	6.7	4.1
June ,,	2.4	6.2	16.8	19.9

Effect of Dusting:

It has been observed in one area which had been dusted for two years at fortnightly intervals that even several months after cessation of the dusting, the rubber samples continued to show a higher copper content, as may be seen from Table 12,

TABLE 12

Copper Content of Samples before the Commencement and Several Months after Cessation of Dusting

Cu in p.p.m.

Sample	Treatment	Mean	% samples over 7.9 p.p.m.	Highest Value
Latex film ...	Before dusting	3.7	0	6.9
	During dusting	9.0	65	11.3
	After dusting	4.7	10	8.6
Panel Scrap ...	Before dusting	4.1	0	6.7
	During dusting	6.4	23	19.5
	After dusting	6.3	20	9.5
Shell Scrap ...	Before dusting	4.7	0	5.6
	During dusting	7.1	34	20.0
	After dusting	5.9	10	14.7

It may be assumed that the increased copper content is due to absorption and assimilation of copper from the copper dust by the leaves and the roots of the tree. From Table 4 it may be seen that the copper in the dusts is to some extent soluble in water. The insoluble copper deposited on the leaves may in addition also be converted into a soluble form by the carbon dioxide in the air and by the ammonium salts present in rain and dew. Furthermore the intact leaves may also produce substances which are capable of dissolving copper from the deposit (22). WAIN and WILKINSON (23) established that solutions of amino acids and certain hydroxy acids and their salts can dissolve considerable quantities of copper.

A further indication for the absorption of copper from copper fungicides either by the leaves or through the roots is the increased copper content of the bark of all parts of the tree. In Table 13 some figures are reproduced. Column A shows the analysis of bark samples from trees of clone Hil 28 which have been spot dusted with "Blendox 6%" compared with undusted samples of the same clone and from the same field. The sampling has been done one week after the dusting. Before taking the samples the bark surface has been thoroughly scraped to remove any surface contamination with copper from dusting and the bark samples down to the wood were removed, by means of a cork borer. Column B shows the results of samples from an area dusted regularly at fortnightly intervals and of the corresponding undusted control area.

TABLE 13

Copper Content of Bark Samples

Cu in p.p.m.

Sample	A		B	
	Undusted	Dusted	Undusted	Dusted
Branches ...	14.2	31.2	19.5	40.0
Above tapping panel ...	10.6	36.2	10.8	22.3
Tapping panel ...	12.4	25.4	10.3	17.4
Below tapping panel ...	9.6	12.2	4.9	12.0
Roots ...	16.0	19.3	10.7	21.1

When copper dusting is carried out in rubber plantations, a portion of the dust falls to the ground. The rest, which settles on the foliage and branches, is gradually washed down the trees by rain. VERMAAT AND VAN DER BIE (24) investigated the occasional occurrence of injurious amounts of copper in latex and concluded that this could be derived from naturally occuring copper in the plant, or by absorption from the soil of copper present in commercial fertilisers or in copper-containing fungicides washed down by rain. Values from 0 to 40 p.p.m. were given for copper originally present in soil and it has been found that by increasing the quantity of circulating organic matter through mulching, more copper could be fixed in organic form, thus depressing the amount of available copper for the trees.

The copper content in the top soil up to 4 inches deep in our regularly dusted area has been found to be 81 p.p.m. whilst that in the top soil from the undusted control area has been found to be 32 p.p.m.

Use of Rainguards to Limit Copper Contamination:

Since experiments on the use of the gutter type rainguards developed by the Ceylon Institute of Scientific and Industrial Research (C.I.S.I.R. rainguard) indicated that it did not eliminate the risk of copper contamination (16), dusting experiments were continued in 1958/59, using two instead of one C.I.S.I.R. rainguard. Dusting has been carried out at two-weekly intervals with 16 lb. of "Blendox 6%" per acre per round in an area of clone PB 183, while the control area was clone Hil 28. The summarized results are given in Table 14.

TABLE 14

Dusting with "Blendox 6%" using 2 C.I.S.I.R. Rainguards 1958/59
Cu in p.p.m.

Sample	Treatment	No. of Samples	Mean	Highest Value	% Samples over 7.9 p.p.m.
Latex film ...	Control	20	4.6	6.6	0
	Without rainguards	20	9.0	11.3	65
	With rainguards	19	6.9	8.9	16
Panel scrap ...	Control	66	4.1	8.1	2
(unprocessed) ...	Without rainguards	88	6.4	19.5	23
	With rainguards	87	6.6	14.6	29
Shell scrap ...	Control	70	3.4	7.4	0
(unprocessed) ...	Without rainguards	91	7.1	20.0	34
	With rainguards	88	6.6	17.8	28
Crepe ...	Control	52	3.0	4.8	0
(Panel scrap) ...	With rainguards	54	4.0	11.8	6
Crepe ...	Control	55	2.4	7.2	0
(Shell scrap) ...	With rainguards	55	4.2	13.4	9

As no tapping had been carried out on dusting days it would have been expected that the latices and scraps of dusted areas protected with 2 gutter-type rainguards should have less copper contamination due to washed down copper than the unprotected trees, but the results show that the reduction is not considerable

and that nearly 30% of the samples of panel and shell scrap have copper values over 7.9 p.p.m. After processing, the crepes have only a slightly increased mean value, with a small percentage of samples above the specification.

Some further experiments have been carried out with a skirt-type rainguard from 300-gauge polythene film over the full circumference of the tree, covering the tapping panel and the collection cup. This rainguard is at the moment being tested in large-scale field experiments, as it is expected to enable normal tapping during the wet season and to minimize or prevent the incidence of Bark Rot. A 1% copper dust with incorporated sticker (Ciba C 115) has been used for dusting at two-weekly intervals at a rate of 8 lb. per acre in plantings of clones Nab 15, Nab 17, Hil 28 and RRIM 501. A summary of the results is reproduced in Table 15.

TABLE 15

Dusting with 1% "Ciba C 115" Dust, using Polythene Rainguards
Cu in p.p.m.

Sample	Treatment	No. of Samples	Mean	Highest Value	% Samples over 7.9 p.p.m.
Latex film ...	Undusted	178	3.6	11.9	4
	Dusted				
	Without rainguards	131	6.2	17.6	23
	With rainguards	55	4.6	18.9	9
Panel scrap ...	Undusted	225	4.3	14.0	5
	Dusted				
(unprocessed) ...	Without rainguards	146	5.5	14.7	16
	With rainguards	55	4.4	10.0	7
Shell scrap ...	Undusted	230	3.5	11.4	2
	Dusted				
(unprocessed) ...	Without rainguards	147	5.4	16.4	16
	With rainguards	55	3.8	14.4	5
Latex Crepe ...	Undusted	12	1.7	2.9	0
	Dusted				
	Without rainguards	25	2.6	7.2	0
	With rainguards	11	2.8	4.9	0

From the results in Table 15 it would appear that the polythene-type rainguard covering the tapping panel does reduce considerably the degree and risk of copper contamination, although it does not completely eliminate it. The mean value of copper in rubber from protected trees is lower than that from unprotected trees, and for panel scrap and shell scrap is equal to the value of the control samples. The amount of individual samples with a copper content above 7.9 p.p.m. is only between one third to one half of the percentage of samples from unprotected trees, and is only slightly higher than from the undusted control samples.

Due to clonal and seasonal variations a small percentage of the undusted control samples have a copper content above 7.9 p.p.m., with maximum values up to about 15 p.p.m., and the possibility that part of the samples from protected trees with a copper content above 7.9 p.p.m. is caused by an increased natural copper content of the trees due to assimilation of copper cannot be excluded. As, however, a great part of this copper is soluble in dilute acids, it is removed during manufacture giving a substantial reduction of the copper content of the latex crepe. Table 16 shows the natural copper content of undusted samples from clones Nab 15, and RRIM 501, used in the experiments.

TABLE 16

Copper Content of Undusted Samples from Clones Nab 15 and RRIM 501
Cu in p.p.m.

Clone	No. of Samples	Latex Film		Panel Scrap		Shell Scrap	
		Mean	% samples over 7.9 p.p.m.	Mean	% samples over 7.9 p.p.m.	Mean	% samples over 7.9 p.p.m.
Nab 15 ...	43	3.5	2	4.1	16	3.5	5
RRIM 501...	43	4.9	7	5.0	2	3.9	5

It must be mentioned that the dusting in our experiments has been very much more prolonged than what is recommended in estate practice. Under normal dusting conditions the risk of direct contamination is less and will be considerably reduced with reasonable care in the field and the application of the recommendations for blending and treatment. An indirect contamination due to the absorption of copper by the tree is mainly a problem in panel and shell scraps and can be eliminated either by suitable blending or chemical treatment. The removal of an excess of copper either from direct or indirect contamination will be dealt in Part II of this paper.

Intervals between Tapping:

From a consideration of contamination it is not possible to suggest the most suitable intervals between the dusting rounds and, therefore, the recommendations from the plant pathological point of view should be followed. The probability of the highest contamination is generally at the first tapping after dusting and after the first shower, but contamination also occurs to an appreciable extent even after several subsequent tappings, depending on the weather, location and other factors. Observance of the recommended precautions and proposed treatments are in our opinion of greater importance than a few days' variation between dusting rounds.

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TAPPING OF HEVEA RUBBER

By

C. A. de Silva

Introduction:

The best tapping system is one which gives the highest yields at lowest tapping cost with the best growth and bark renewal, the lowest rate of bark consumption and the lowest incidence of bark diseases. It is an accepted fact that yield is taken at the expense of growth. The introduction of the "Double-Four" system at the commencement of tapping results in a marked set-back to growth. On older trees this set-back is less immediately apparent, but any method of tapping resulting in greatly increased yields must, in the long run, have an adverse effect on the bark renewal during the first and second tapping cycles. In Ceylon, leaf-fall, caused by *Oidium heveae* and *Phytophthora palmivora* insufficiently controlled, is an added contributory factor to poor bark recovery. The choice of a suitable tapping system must be, primarily, a judicious compromise between the two interacting factors of yield and growth. During the early years of tapping consideration must be given to the incidence of Brown Bast on high-yielding clones and clonal seedlings. It is best to take the long view and to train the trees during the early years of tapping to their ultimate task of producing economic yields throughout their tapping life.

Standard of Tappability:

Both budded and seedling trees can be regarded as tappable when they have attained a girth of 20 inches at a height of 3 ft., measured from ground level in the case of seedling trees and from the highest point of the union in the case of budgrafts.

A new planting may be brought into tapping when approximately 70 per cent of the trees have reached tappable girth.

An increase in the standard of tappable girth will result in a loss of crop due to the postponement of tapping. In an experiment carried out with 8 clones, trees which were brought into tapping at an age of 6 years with an average girth of 19½ inches were compared with trees of the same clones which were not tapped until they were approximately 8 years old with an average girth of 26 inches. When the yield results were compared it was found that the second group of trees gave in its 8th year of age and in the first year of tapping approximately the same average yield per tree per year as the first group of trees in its 7th year of age in the second year of tapping. It would seem, therefore, that clonal rubber has to be trained to a yield response as early as possible without a serious set-back to the growth of the young trees by adopting the correct initial intensity of tapping. In general, other factors being equal, a tree which has been tapped previously will give a higher yield than one which has not.

Choice of Tapping Systems:

Buddings.—There is no one system which is best suited to all clones under all conditions. Where conditions of growth are poor the high-yielding clones are

best tapped on the reduced intensity of 67 per cent for the first three years, and thereafter it should be possible to assess the risk of increasing the tapping intensity in any particular area, due consideration being given to the early incidence of Brown Bast.

For most clones the half-spiral alternate-day system of 100 per cent intensity will be satisfactory from the commencement of tapping, especially in the wet low-country districts. In the case of clone Glenshiel 1 a tapping system of 67% intensity should be adopted permanently. In certain instances, under particular conditions of growth, it is possible to adopt 100 per cent tapping intensity on the S/2, d/2 system for clone Gl 1 from the fourth year of tapping, without an unduly high incidence of Brown Bast.

In the case of moderately high-yielding clones, which do not show a high incidence of Brown Bast in the early years of tapping, the double-four system (2S/2, d/4, 100%) may be introduced in the fourth year of tapping on a change-over system indicated in Diagram 3. Increased yields of 15 to 20 per cent can be obtained at a lower tapping cost compared with the single-cut system of 100% tapping intensity.

Some high-yielding clones can be tapped on the double-four tapping system later in the first tapping cycle, with the second cut opened in renewed bark; the 10th year of tapping would be convenient for a change over to a double-cut system (see Diagram 3).

The previous history of Brown Bast in a particular block should be considered in making a decision to introduce the double-four tapping system. A stand of rubber showing a high incidence of the more recent cases of Brown Bast, that is, over 10 per cent of the trees, would be suspect for tapping on the double-four system.

Clonal Seedlings.—It is increasingly evident that high-yielding clonal seedlings can show a high incidence of Brown Bast during the first 3 to 4 years of tapping at 100% intensity. *A 67% tapping intensity is therefore recommended for the first 3 years of tapping, which will include the period when high initial stands of clonal seedlings will be further reduced to 130 to 140 trees per acre on a basis of yield and incidence of Brown Bast; the first thinning out on the basis of vigour of growth having been done in the first three years from planting.* The more permanent stand of 130 to 140 trees per acre can then be tapped at a 100% intensity on the S/2, d/2 system from the 4th year of tapping.

Bark Consumption:

In Ceylon the Michie-Golledge knife is in general use. The bark consumption for the tapping year and tapping heights for a particular tapping cycle are based on 20 tapping cuts per inch of bark.

The bark consumption for any tapping year will vary according to the total number of tapping days. There is no evidence to prove that thicker bark shavings give increased yields. For a given interval of tapping, depending on climatic conditions, the latex vessels should be effectively opened for the free exudation of latex. Somewhat thicker shavings are necessary after periods of rest, or if a four-day interval is adopted, due to the drying out of the cut surface to a greater depth. The double-four system is not normally recommended for the drier districts of Galle and Matale on this account.

Working on a basis of 280 tapping days per year the bark consumption will be as follows:—

Tapping Interval	No. cuts per tree per year	Bark consumption per tapping year
Once in 2 days	140	7 inches
„ „ 3 „	94	4.7 „ (5 inches)
„ „ 4 „	70	3.5 „ (4 inches)

In the three and four-day systems a slightly higher rate of bark consumption per tapping can be expected due to the increased interval between tappings, especially during the drier periods, and the consumption per year would be nearly 5 inches and 4 inches respectively, as indicated above in brackets.

There has been a considerable improvement in the selection of seedling stocks in the post-war period and tapping can be continued down to the union of budded trees, thus allowing for an approximate tapping cycle of 12 years on budded trees, with the cuts opened at a maximum height of 42″ from the union.

It should be stressed that a tapping rate of so many inches per month or per year cannot and should not be adhered to if rational tapping is required. The criterion of tapping is 1/20 inch of bark per tapping, not a fixed bark consumption per month. The number of cuts per month varies with the number of tapping days, *i.e.* in a wet month with a reduced number of tapping days the number of tappings x 1/20th inch of bark should be consumed. The practice of marking on the tree the amount of bark to be consumed per month is dangerous in this respect, as in a wet month the tapper is likely to cut thicker shavings and thus waste bark in order to use up the marked amount. If any markings are made they should merely be used to indicate a maximum for the period concerned.

Height of Opening and Slope of Cuts:

The yields of budded trees, unlike those of seedling trees, do not decrease appreciably with increasing height of tapping. Budded trees can, therefore, be tapped higher up the cylindrical trunk without an appreciable loss in crop. In seedling trees the stem shows a pronounced taper from ground level to a height of about 4 feet and the lower half of the tapping panel has a higher concentration of laticiferous tissue, as well as a greater length of cut compared with the upper half. As the best yields are obtained by tapping at the lowest level consistent with adequate bark renewal it is, a definite advantage to keep the cuts low on seedling trees. It is also undesirable to leave isolated patches of untapped bark (bark islands) at any stage of the tapping history of a tree. In keeping with these views the initial cuts on both seedlings and budgrafts are opened at heights which will allow the maximum rate of bark consumption for any recommended system of tapping on a minimum renewal cycle of 8 years.

In these recommendations no provision is made for the reduction of tapping heights to conform to the reduced intensity of tapping at 67% and the maximum heights given below provide for 84 inches of tappable bark, 42 inches on each half-circumference panel on the main stem (see Diagram No. 1). The tapping at 67% intensity is a temporary phase, which is followed by 100 per cent intensity tapping on a double or single-cut system.

Clonal seedlings.—Tapping cuts on the first and subsequent panels should be opened at a height of 36 inches measured from ground level to the lower end of the tapping cut. The angle of the cut from the horizontal should be 25 degrees and must slope downwards from left to right. This angle is sufficient for the satisfactory flow of latex along the thicker bark of seedling trees as compared with that on budgrafts and leaves a smaller

triangle of untapped bark at the base of the tapping panel, thereby providing for a maximum amount of tappable bark in an area which gives the best yields on seedling trees (see Diagrams No. 1 and 2).

Buddings.—Tapping cuts should be opened at a height of 42 inches measured from the highest point of the union to the lower end of the tapping cut, the angle of the cut to be 30° from the horizontal.

In commercial practice two stencils are made of aluminium sheet for budded and seedling trees. These are used to mark the trees with the correct angles for the cuts and for the rate of bark consumption allowed for the tapping year.

Tapping cuts on trees not initially taken into tapping due to poor girth development should be opened at the maximum heights adopted for the rest of the stand and not at the existing heights of cuts on trees initially tapped. Opening new cuts at existing heights defeats the purpose of our recommendations, as the undesirable "island" of virgin bark will appear during the course of the tapping history of such trees.

Depth of Tapping:

The most active latex vessels are concentrated close to the cambium in the soft bark. The outer bark with the characteristic "stone-cells" contain the less efficient, sparsely distributed, and discontinuous latex vessels. *The best yields are obtained by tapping to a depth of within 1 millimetre of the cambium.* The best tappers do this without injuring the cambium. The absence of these injuries on tapping panels is not always a sign of good tapping, however, as this may be due to too shallow tapping which gives reduced yields.

Direction of Tapping Cut:

The latex vessels are inclined to a slight angle of about $3\frac{1}{2}°$ to the right up the stem, that is, in an anticlockwise spiral upwards. The greater number of latex vessels are therefore severed when the tapping cuts are made to slope from high left to low right. Experiments have shown that an average decrease of about 10 per cent may result if the cut slopes in the other direction, that is from right to left.

Tapping Knives:

The Michie-Golledge knife used in Ceylon is well adapted for a high standard of tapping with a minimum consumption of bark. It calls for a certain dexterity in guiding the knife correctly and gives a cleaner cut than the types of draw-knife used in other countries. With this knife the average tapper may find it difficult to work on cuts over 42 inches in height, as the top end of the cut is then beyond his reach for downward tapping and for this reason we have recommended this height of opening of tapping cuts on budded trees.

The drawknife is well adapted for high tapping and the bigger task. Ceylon can ill afford the higher rate of bark consumption associated with this type of knife which is used in Malaya for quick tapping on large tasks, generally on a contract basis.

Time of Tapping:

The latex production of Hevea is at its highest in the early hours of the morning, and the later the commencement of a day's tapping the smaller the amount of latex obtained.

The pressure for exudation of latex is highest during the night and in the early morning as the humidity of the air is then at its maximum and transpiration, which entails the loss of water through the leaves, is at its lowest. The loss of water by transpiration later in the day reduces the internal turgor pressure resulting in a reduced exudation of latex. In general the rate of decrease depends on the weather conditions of each day and is also affected by the soil moisture content.

Size of Tapping Task:

Tapping and latex collection may account for almost 50% of the total cost of production. It is essential, therefore, to reach a satisfactory compromise between the size of the tapping task and the efficient intake of latex by a consideration of the local terrain and climate.

In general we consider that tapping tasks of 150 trees on the double-cut and of 250 *trees on the single-cut systems are satisfactory.* The closer planting introduced in recent years on the "Avenue" planting systems on difficult land presents considerable scope for greater efficiency of tapping with increased size of tapping tasks.

Tapping Systems:

(1) *The Half-Spiral Alternate-Day System* (*S*/2, *d*/2, 100%). In this system one half-circumference cut is tapped once in 2 days. On the basis of 280 tapping days per year each tree will be tapped on 140 days. The bark consumption will be 7 inches at 20 cuts per inch. On budded trees the 84 inches of tappable bark on the two panels will provide for a tapping cycle of 12 years. In the case of seedling rubber the 72 inches of tappable bark on the two panels will provide for a tapping cycle of 10 years.

(2) *The "Double-Four" System* (2*S*/2, *d*/4, 100%) has two half-circumference spiral cuts tapped once in 4 days. On 280 tapping days per year each tree will be tapped on two cuts on 70 days. Theoretically 3½ inches of bark will be taken off on each cut per year. A somewhat higher bark consumption can be expected in the drier districts on a 4-day tapping interval. This allows for a total bark consumption of about 8 inches per year, with a 10-year cycle for budded trees and a 9-year cycle for seedling trees.

(3) *The Half-Spiral Third-Day System* (*S*/2, *d*/3, 67%) has one half-circumference spiral cut tapped once in 3 days. This tapping system is used for the first three years of tapping on certain high-yielding clones and clonal seedlings in general. On 280 tapping days per year each tree will be tapped on a single cut on 94 days, the bark consumption will be 5 inches per year. The cut is opened at the maximum height of 42″ from the union on each tapping panel on budded rubber trees and 36″ from ground level on seedling trees.

(4) *The "Double-Three" System* (2*S*/2, *d*/3, 133%).—In the prewar period tapping on two half-spiral cuts once in three days was looked upon as a "slaughter" tapping system. During the last world war an effort was made to produce the

maximum possible crop as an emergency measure, and the double-three system was used for tapping seedling rubber of about 25–30 years of age for maximum crop.

In more recent times the double-three system has been used for tapping budded rubber before the completion of tapping on the first renewed bark, and the results have been very disappointing from the point of view of obtaining increased yields over a prolonged period; this is not unexpected. *The early introduction of the double-three system of tapping on budded or seedling rubber yielding over* 1,000 *lb. dry rubber per acre per year is not recommended.*

It would not be correct to use the double-three system for tapping budded rubber or clonal seedling rubber until it is definitely known that such material will be due for replanting within 8 to 10 years from the commencement of tapping on the double-three system. In obtaining increased yields, so much depends on the previous history and the agricultural practices of the areas in which the double-three system is used.

The double-three system should not be adopted until the tapping on first renewed bark is completed. The system can be used for tapping budded and seedling areas with its full tapping intensity of 133 per cent within 5 years of replanting. Any earlier introduction of the double-three system should be on a reduced actual tapping intensity of about 114 per cent, with no tapping on Sundays, or by allowing for losses of tapping days through rain in the wet low-country districts.

Change-Over Systems of Tapping:

We advise the change-over system, as in Diagrams 3 and 4, primarily for making provision for tapping on a double-cut system after the end of the 3rd year of tapping on budded and clonal seedling trees.

In the case of budded trees, with the initial cut opened at a maximum height of 42 inches, *the change over will be effected from panel* 1 *to panel* 2 *when the cut on panel* 1 *is about* 21 *inches in height at approximately the end of the third year of tapping;* thereafter a change over of cuts is made from year to year between the two panels. (See Diagram 3).

In the case of seedling trees the initial cut is opened at a height of 36 inches. *The change over of the tapping cut can be made at the end of the third year of tapping;* thereafter a change-over of cuts is made from year to year between the two panels. (See Diagram 4).

On a reduced intensity of tapping of 67% on the S/2, d/3 system, the first change over is made when the tapping cut is approximately half way down the first tapping panel or when the bark consumption has reached approximately one quarter of the consumption on a 12 year or 10 year cycle provided for the budded and seedling trees respectively.

If there is no intention of tapping on a double-cut system in the future, tapping should be continued down the whole length of the first panel, before the change over to the maximum height on the opposite panel. It is possible on the above procedure to introduce a double-cut system at the end of the 9th year of tapping in the case of budded rubber and at the end of the 8th year for seedling rubber. The double-four system (2S/2, d/4, 100%) is of considerable importance for future tapping, as it is a more economic system than the standard half-spiral alternate-day system of 100% intensity. The change over to the double-four system, when made as recommended provides for the cuts on opposite panels remaining widely separated.

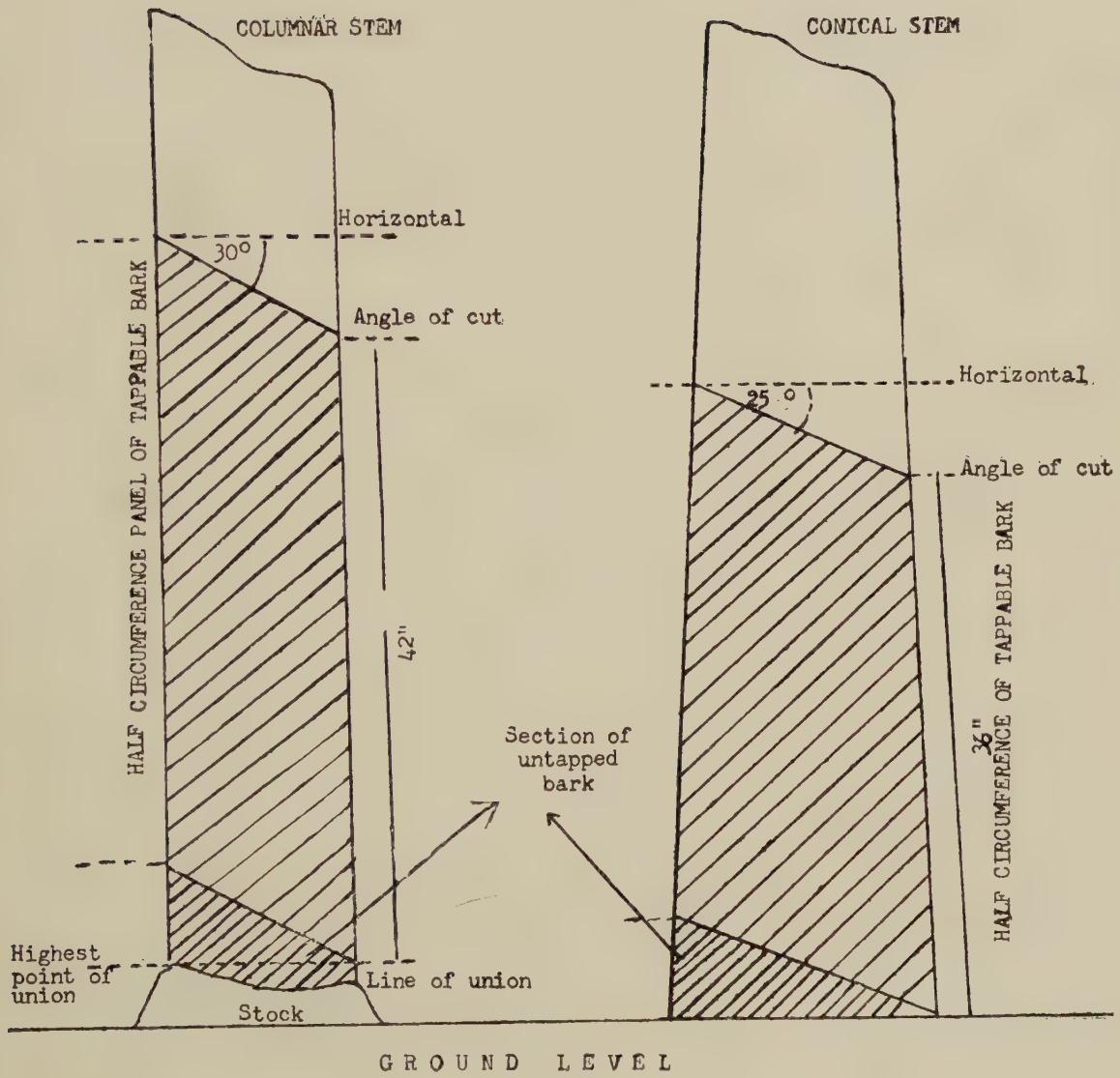
TAPPING HEIGHTS AND SLOPE OF CUTS

DIAGRAM 1.

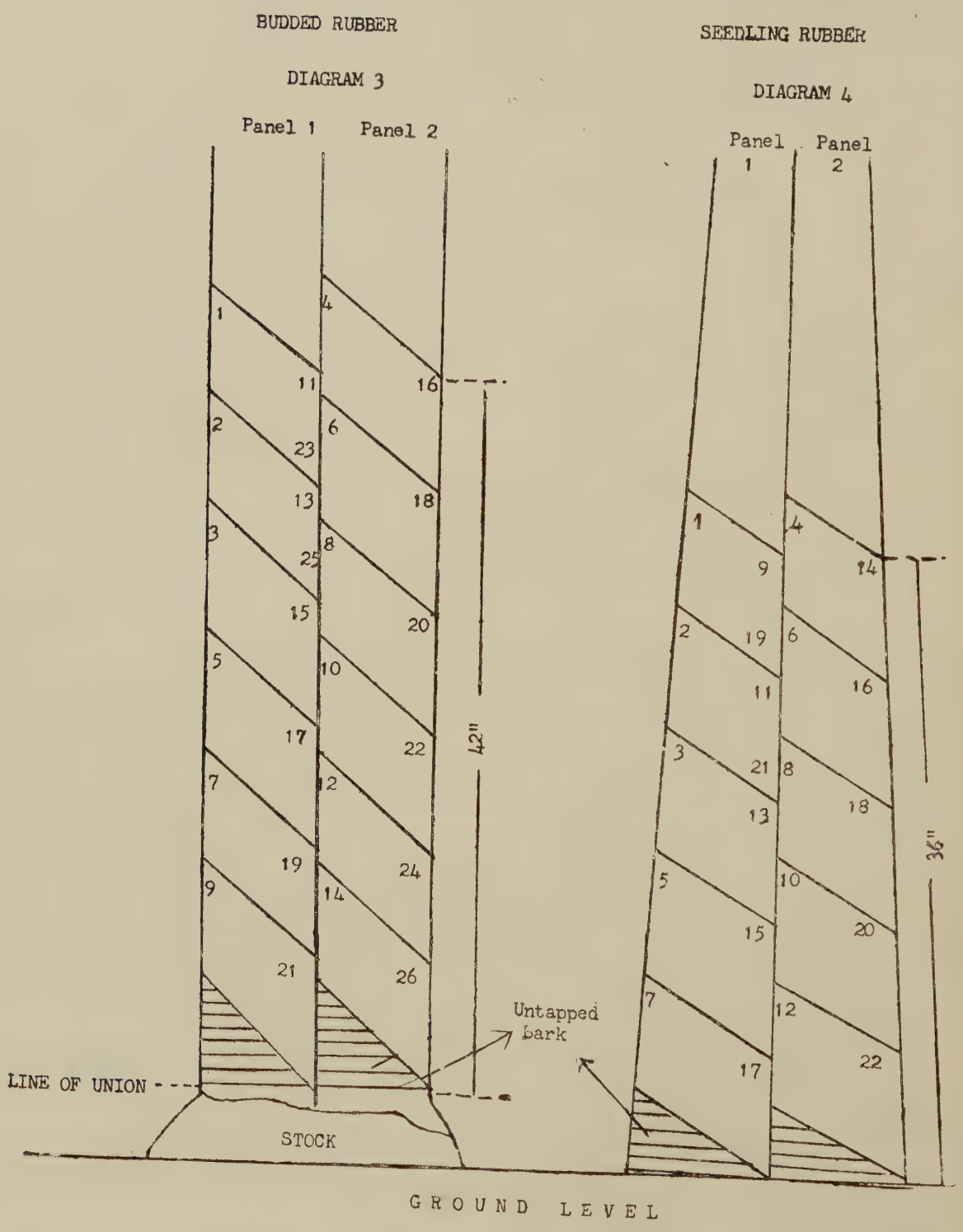
BUDDED RUBBER

DIAGRAM 2.

SEEDLING RUBBER



CHANGE-OVER SYSTEM FOR SINGLE HALF-SPIRAL CUTS



REPORT ON THE SULPHUR DUSTING OF SMALLHOLDINGS IN 1961.

By

A. B. Dissanayake

Introduction:

The State-aided Co-operative Sulphur Dusting Scheme which is organized every year by the Smallholdings Department of the Rubber Research Institute of Ceylon for the purpose of controlling *Oidium* leaf disease on smallholdings was successfully completed for the year 1961. In organizing this scheme the Smallholdings Department provides sulphur dusting machines to the smallholders free of charge and the necessary technical advice and guidance in organizing the sulphur dusting groups and carrying out the dusting, while sulphur dust of approved quality is supplied at a subsidized rate of half the price to smallholders (owning under 10 acres). Throughout the dusting season the Rubber Instructors and the supervisory field staff of the Department supervise the dusting operations. The actual dusting is started every year round about mid January and concluded round about late March or early April.

Organization:

The usual procedure followed in earlier years was adopted this season also. The advice and the necessary propaganda for the formation of co-operative groups commenced at the end of July. Application forms and the Smallholdings Folder No. 4A which explains the Sulphur Dusting Scheme in detail were printed both in Sinhala and English and were distributed among the smallholders in August 1960. The usual press notification drawing the attention of the public to the control of *Oidium* in smallholdings by sulphur dusting was published in the popular Sinhala and English papers during the first half of September 1960.

As a result of the publicity given to the State-aided Sulphur Dusting Scheme by means of the propaganda work of the Publicity Unit, advisory work of the field staff, press notification etc. it was possible to exceed the target fixed for the year 1961.

Necessary instructions regarding correct procedure of dusting were given to all staff prior to commencement of dusting. These instructions covered the proper maintenance of dusting machines, supervision of dusting, submitting daily, weekly and monthly reports on the progress and results of dusting and the checking of accounts of incidental expenses of different co-operative dusting groups. All the forms necessary for these purposes were distributed among the staff well in time.

Collection of money for incidental expenses in the Co-operative Dusting Scheme was one of the biggest difficulties which had to be overcome. As in previous years only Rs. 5.00 per acre were collected from the group members for incidental expenses. In many cases the Rubber Instructors and the supervisory staff had to personally see to the collection of money, which was completed by the end of December 1960.

This season it was possible for the Department to have its own Mechanic to attend to the servicing and repairs of the dusting machines, amounting to 117 in number. Major repairs, however, were handed over to the agents. Each accepted co-operative dusting group was issued a sulphur dusting machine on loan. Spare machines were made available at central spots to avoid interruption of dusting due to machine breakdown. Discussions during the monthly Staff Conferences held in the six Divisions during the period July to September helped to solve difficulties which cropped up during the period of group formation.

By the end of September applications were received from 89 tentatively formed groups. Three groups, however, could not be included in the Scheme due to insufficient acreage in the groups, failure in making payment for sulphur in time and general lack of co-operation among the smallholders. Thus only 86 dusting groups comprised of 2,592 holdings, giving a total acreage of 8,835, were accepted for dusting. (Table I & Annexure I)

TABLE I

District	Acreage		Holdings	
	1960	1961	1960	1961
Kalutara ...	2091¾	2347½	608	629
Colombo ...	1548½	1831¾	491	603
Kegalla ...	1846¼	2015¼	797	748
Ratnapura ...	1297¾	1278½	360	389
Galle ...	808¾	797½	139	128
Matara ...	514¼	564½	70	95
Kandy ...	67¾	—	39	—
Total ...	8175	8835	2504	2592

The distribution of co-operative sulphur dusting groups according to Districts are given in Table II and Annexure 2.

TABLE II

District	Distribution of Groups	
	No. of Groups 1960	No. of Groups 1961
Kalutara ...	20	22
Colombo ...	15	17
Kegalla ...	20	23
Ratnapura ...	13	12
Galle ...	8	7
Matara	5	5
Kandy ...	1	—
Total ...	82	86

As in previous years, Kalutara continued to be the single district with the largest acreage dusted, *i.e.* 2,347½ acres as against 2,091¾ acres last year. This year the smallest acreage dusted in a single district was Matara with 564½ acres,

as the Kandy district which had one co-operative dusting group functioning last year failed to participate in the Scheme this year due to lack of sufficient number of smallholders to form an economic co-operative dusting group.

This year some of the very old co-operative sulphur dusting groups were made to function on their own with no help from the Department. In these groups under the guidance of their energetic Group Organizers, collection of money, transport and distribution of sulphur dust, dusting and all other work in connection with dusting were done by the group members themselves. Such self help will be a great asset in expanding the State-aided Sulphur Dusting Scheme without additional staff if this scheme is to be successfully operated in the future.

Dusting Operations:

Defoliation was observed to be uneven. At the time of refoliation unusual showers and very low temperature slightly interrupted dusting operations in certain areas.

Each group had its Machine Operator and the two labourers to carry the machine. The machine operators of the newly formed groups, who have had no earlier experience in sulphur dusting, were given demonstrations and training classes. The Rubber Instructors were instructed to personally supervise the first two rounds of sulphur dusting in all groups. Subsequent rounds of dusting were supervised as duties permitted. Almost all groups had their five rounds of dusting. A few cases, however, were reported where the fifth round of dusting could not be given as the smallholders failed to bring the sulphur to their holdings. In some cases as much as seven rounds had to be given due to very uneven refoliation.

Dusting operations were commenced on 9-1-61 in Pelmadulla Co-operative Sulphur Dusting Group in the Pelmadulla range. The first dusting group to complete dusting was the one organized at Udagoda (Undugoda Range) where the final round was completed on 11-2-61. The dusting operations for the season were concluded on 1-4-61 when the last holdings of the Kotawella Group (Kegalla Division) were given their fifth round of dusting (Chart II).

It has been reported that a number of groups had to start sulphur dusting as early as 2.30 a.m. in order to complete the day's dusting programme by 7.30 a.m. Machine breakdowns, too, were reported. Very minor repairs were attended to locally, while the Departmental Mechanic attended to all others except the very major repairs which were handed over to the agents of the machines.

Results:

The holdings which participated in the Co-operative Sulphur Dusting Scheme have been successfully protected against *Oidium* infection. It has been observed that whilst undusted holdings were infected severely by *Oidium*, the degree of attack being more than that observed last year, the dusted holdings generally escaped attack. In a very few cases, where wintering was very late and where rain interfered with sulphur dusting, a slight amount of infection was noticed in the dusted holdings.

Summary:

Number of holdings dusted	2,592
Acreage dusted	8,835
Number of groups which functioned	86
Number of machines used	117
Acreage per machine	75½ acres approx.
Average size of a holding	3 2/5 acres „
Size of the smallest holding	¼ acre
Size of the largest holding	31 acres
Average number of holdings in a group	30
Average cost of dusting an acre, including sulphur ...	Rs. 12.39

The total extent of 8,835 acres dusted in 1961 constitutes the largest extent of smallholdings dusted against *Oidium* in a single season (Annexure 3).

The smallest holding to be dusted was ¼ of an acre in extent. The total acreage dusted consisted of 6,643¼ acres of budded rubber, 1,340¾ acres of clonal seedling rubber and 851 acres of ordinary unselected seedling rubber (Annexure 4). Of the total acreage, 6,718 acres, *i.e.* 76% were provided with subsidized sulphur at a rate of Rs. 6.05 per acre and 2,117 acres were supplied with sulphur dust at the non-subsidized rate of Rs. 12.10 per acre. The attached Charts (I & II) give further details of the dusting work in 1961. The total average cost of dusting an acre was Rs. 12.39, including the cost of sulphur.

Follow-Up:

As done in previous years a questionnaire was distributed among the Rubber Instructors towards the end of the dusting season for the purpose of finding out the true position of dusted and undusted holdings after a period of time. Rubber Instructors were instructed to visit all dusted holdings, meet smallholders and report on these areas, after 6 weeks from the completion of dusting. Results are tabulated in Chart III.

The answers to the questionnaire reveal that:—

1. Almost all the dusted holdings were free of *Oidium* while the undusted holdings were heavily infected.

2. Incidence of disease in general has been heavier than last year in undusted holdings.

3. Even in dusted holdings, especially in the late winterers, infection of *Oidium* appeared on a small scale.

4. Almost all the smallholders who took part in this Scheme this year have expressed their willingness to participate in the Scheme in the coming year as well.

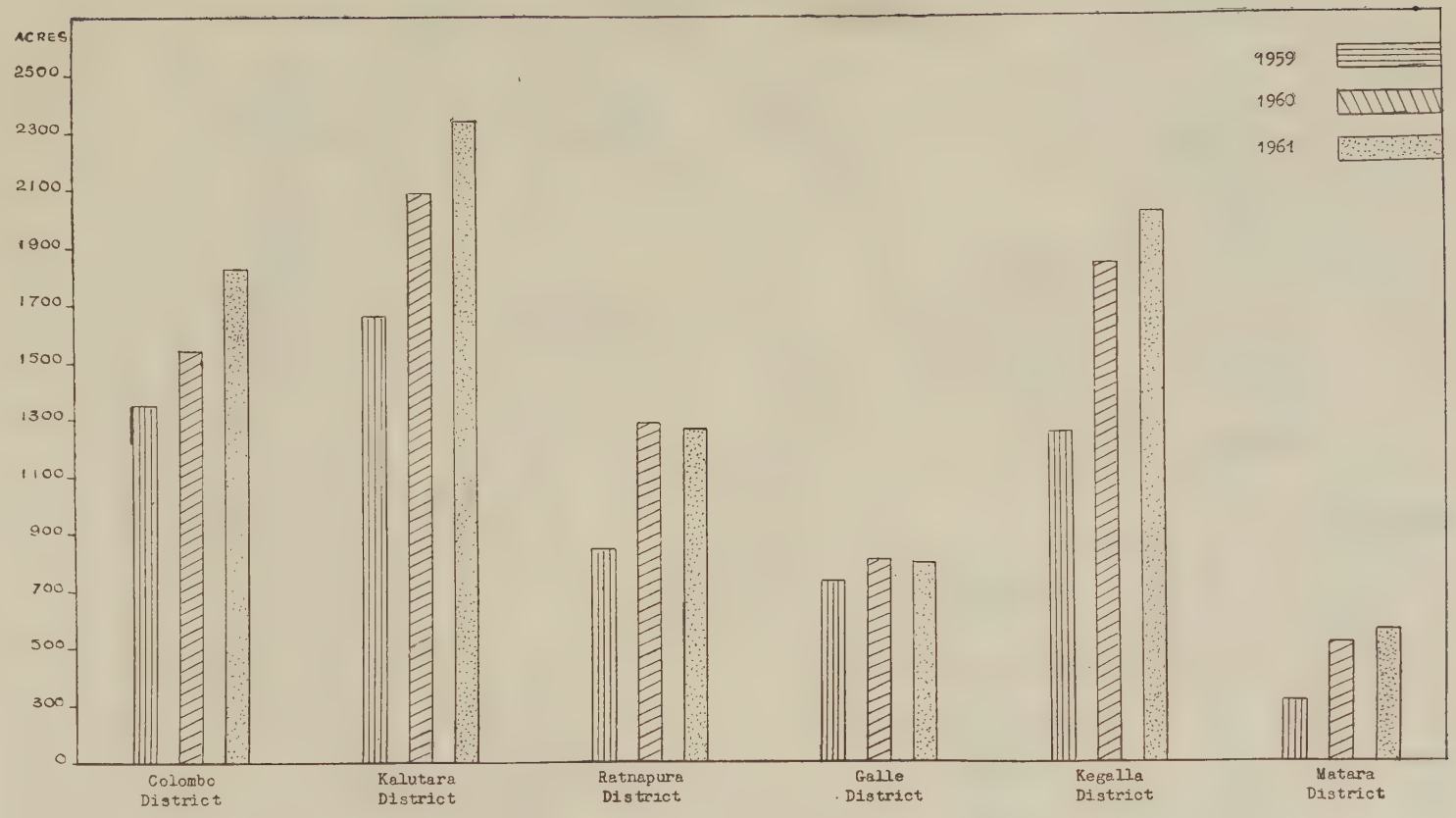
Acknowledgements:

The writer gratefully acknowledges the wholehearted co-operation and assistance extended by the entire staff of the Smallholdings Department for the successful completion of the State-aided Sulphur Dusting Scheme for Smallholdings in 1961.

ANNEXURE I

PROGRESS IN SULPHUR DUSTING OF SMALLHOLDINGS

1959 - 1960 - 1961



1959 Dusting Season - 6246¾ Acres
1960 -do- - 8175 "
1961 -do- - 8835 "

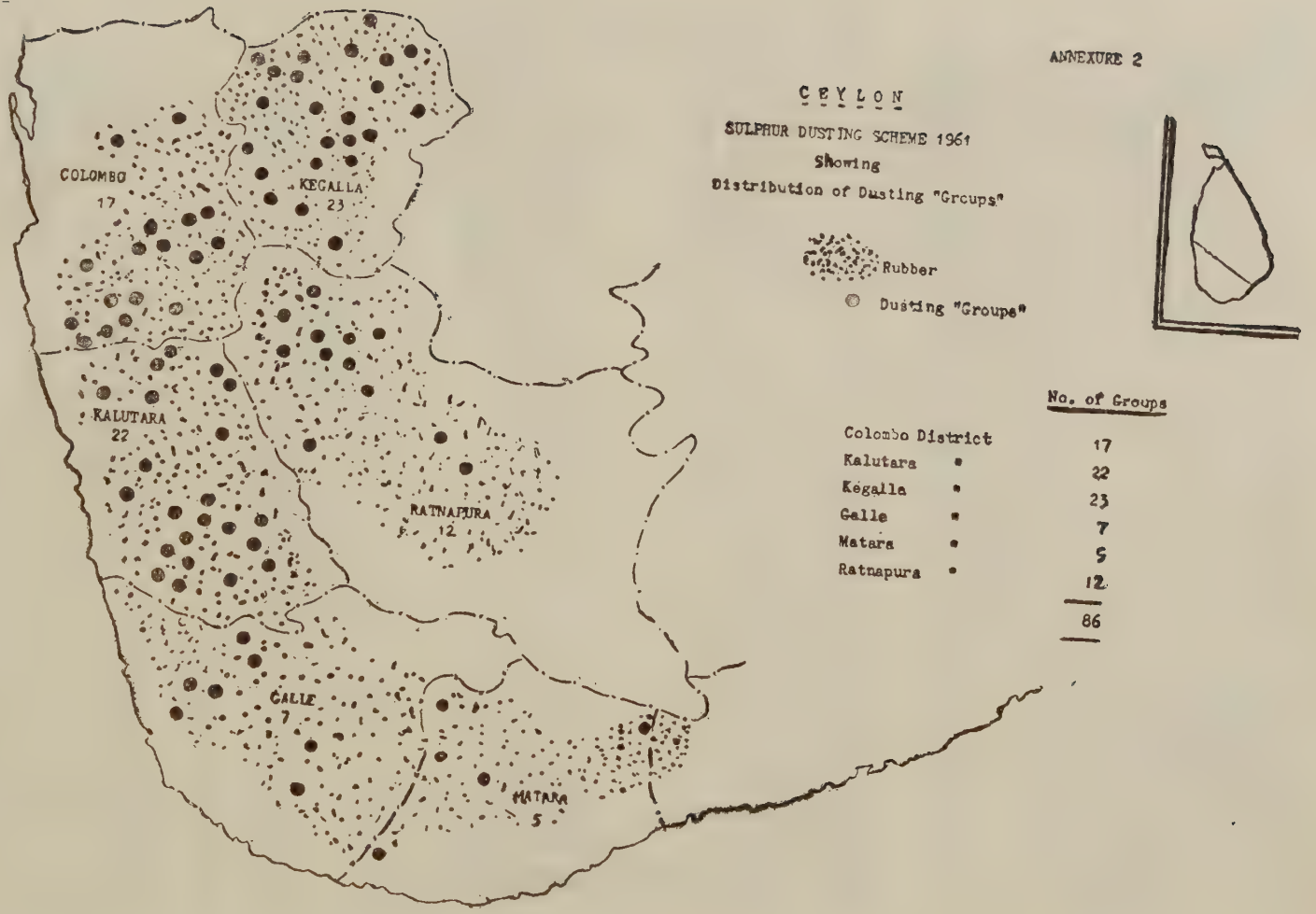
ANNEXURE 2

CEYLON

SULPHUR DUSTING SCHEME 1961

Showing

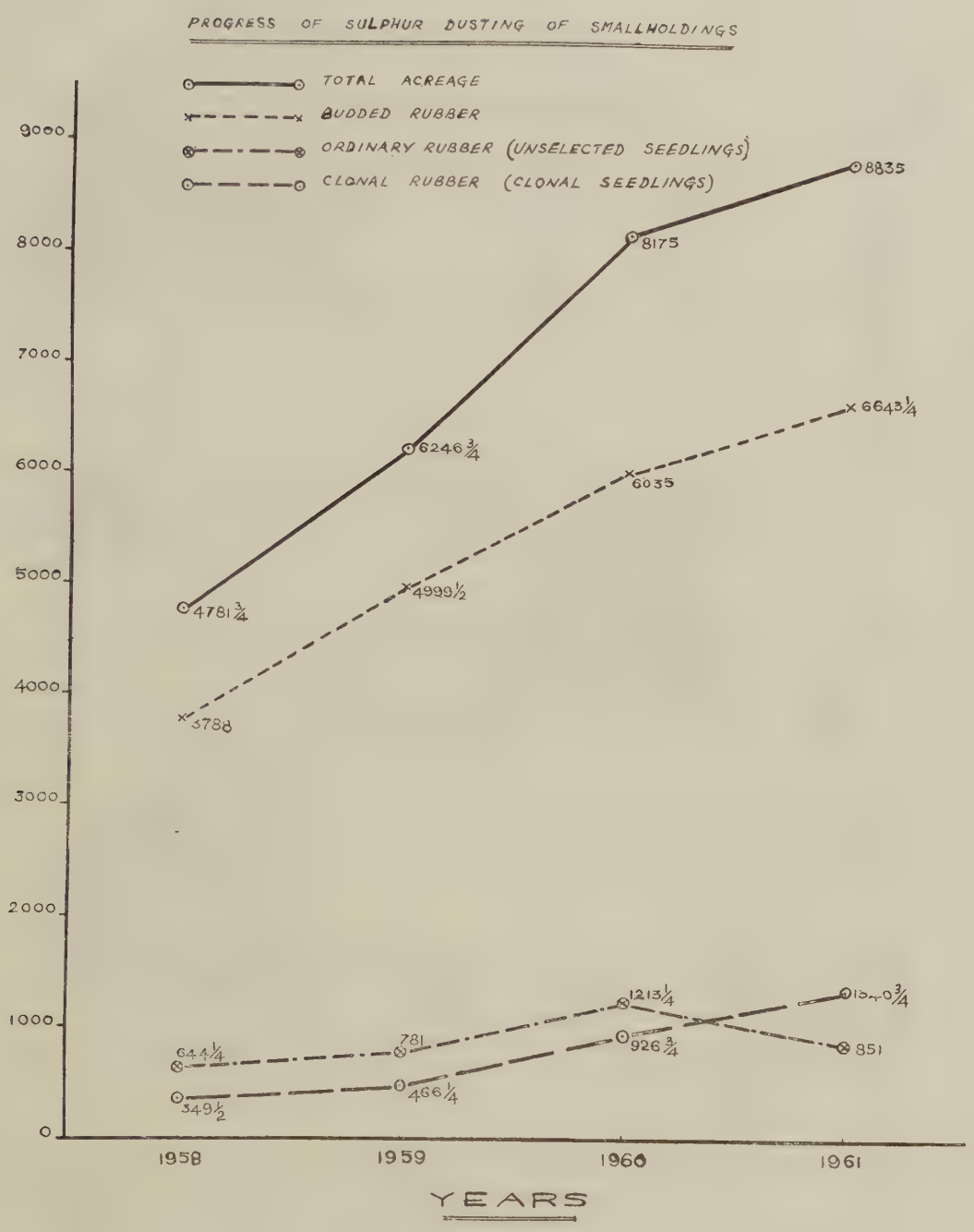
Distribution of Dusting "Groups"



Rubber

Dusting "Groups"

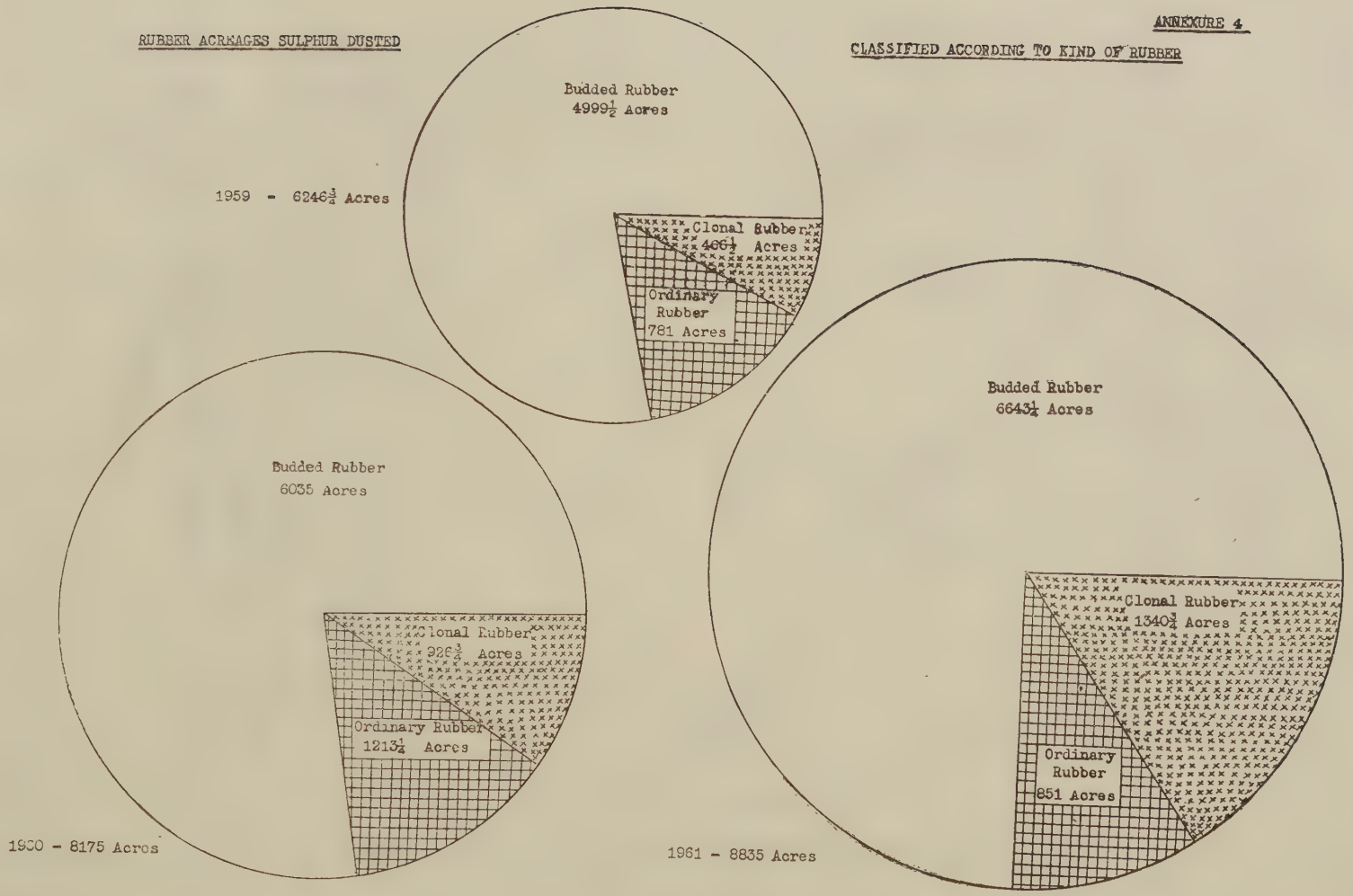
	No. of Groups
Colombo District	17
Kalutara "	22
Kegalla "	23
Galle "	7
Matara "	5
Ratnapura "	12
	86


PROGRESS OF SULPHUR DUSTING OF SMALLHOLDINGS
TOTAL ACREAGE
BUDDED RUBBER
ORDINARY RUBBER (UNSELECTED SEEDLINGS)
CLONAL RUBBER (CLONAL SEEDLINGS)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
8835
8175
6246 3/4
6643 1/4
6035
4781 3/4
4999 1/2
3788
1213 1/4
1303 3/4
781
644 1/4
926 3/4
851
466 1/4
349 1/2
1958
1959
1960
1961
YEARS

ANNEXURE 4

RUBBER ACREAGES SULPHUR DUSTED

CLASSIFIED ACCORDING TO KIND OF RUBBER



PLANTING TOPICS

Wind Damage in Rubber Plantations

In recent years attention has been drawn to the increasing incidence of wind damage which has been responsible for appreciable losses of high-yielding rubber trees in the early years or tapping, both in Ceylon and in Malaya.

In order to correctly assess all the factors which contribute to the inherent weakness of various types of planting material as a predisposing cause of wind damage, a number of field investigations have been carried out in Malaya.

The main forms of damage can be broadly classified as branch damage, trunk snap and uprooting.

The density of the foliage canopy, in all cases, plays an important part in the incidence of wind damage. In Ceylon many years of successful control of leaf disease caused by *Oidium heveae* have resulted in the best development of foliage seen for the past 30 years. This heavy foliage is a strong contributory factor to the increased incidence of wind damage experienced in recent years.

We have two monsoons each year with stormy periods, which affect the rubber planted on certain aspects of land in the variable topography of rubber land in this country. The location of rubber planting material then becomes an extremely important factor in the general incidence of wind damage during the susceptible period. Some of our best high-yielding clones, with no marked inherent weakness to wind damage, can suffer considerable damage by monsoon storms which are freak occurrences in particular locations.

We have also to face the fact that in recent years wind belts of natural high jungle have been cut out over large areas in the rubber planting districts and the rubber areas themselves now stand up as the first line of defence against monsoon storms.

A continuous canopy will give the best protection against heavy damage. This is not often achieved in areas which have large open avenues due to roads and open pockets with buildings. Open valleys with large tracts of high rubber land on eastern and western aspects come in for heavy damage as the wind rushes through the open avenues of least resistance up the hillsides. Wide avenue planting systems are, therefore, not favoured and thinning out of unwanted trees must be carried out as early as possible so that a continuous foliage canopy is established.

Branch damage can be minimized by a selection of clones of the most desirable types of branching against wind damage. Judicious early pruning will help, if a weak crotch is formed by early acute-angle branching.

Wind damage due to trunk snap presents more subtle problems for investigation in finding remedial measures against such damage. The crown, height of tree, structure of the timber and many other factors connected with the genetic constitution of the planting materials play their part in the susceptibility to trunk snap.

With selected clones that are now showing trunk snap on a large scale because of their inherent weakness or incorrect location, preliminary attempts have been made to ease the stress on the trunk by pruning the branches or pollarding the trunk itself. Under such conditions the weakness of the limited regenerated foliage to support the main trunk leads to a physiological inactivity of the trunk which becomes susceptible to the heat action of the strong sun, leading to bark damage. Such unforeseen repercussions of heavy pollarding indicate that these remedial measures cannot be undertaken without further careful studies of this particular method of minimizing wind damage.

We have also pointed out that in the case of losses of trees by uprooting, the poor development of the taproot, due to the underground presence of rock or lateritic hard pans, results in poor anchorage. Such losses are not attributed to any inherent susceptibility of the planting material to wind damage.

Discussions at the proceedings of the Natural Rubber Research Conference held in Malaya in 1960 tentatively indicated that "breakage was most severe in high-yielding clones which were vigorous during immaturity but girthed slowly when exploited".

In the case of manuring, high nitrogen applications have resulted in increased incidence of wind damage. The effects of potassium and phosphorus in relation to wind damage in *Hevea* appear to be conflicting.

It would appear, therefore, that with so many factors involved in rendering rubber trees susceptible to wind damage, it is necessary to select high-yielding clones which are wind resistant for planting in locations known to be exposed to heavy monsoon storms. Clones Mil 3/2, RRIC 52, Glen 1, and even PB 86, have shown appreciable tolerance to wind damage in this country.

C. A de S.

QUESTION CORNER

Question:

Can you please advise me how to prevent the development of coloured spots in crepe rubber? A sample of such a stained crepe is attached. I may mention that my factory is only equipped with an unheated drying loft.

Answer:

The coloured spots observed on crepe rubber are caused by various micro-organisms (fungi and bacteria) which may develop during manufacture and/or subsequent storage. All raw rubber contains spores of these microorganisms which, under suitable conditions, as when the rubber is dried too slowly or when it becomes damp during storage, may develop and produce differently coloured stains. The average drying time for crepe rubber in fine weather is 4–5 days but during wet spells it may be considerably longer. Poor air circulation in the loft will be a contributory factor to the development of mould. It is therefore necessary to ensure a good air circulation. Densely grown trees around the drying loft may sometimes prevent free air circulation. Further it is appropriate to have only the windows at two opposite sides of the drying loft, in the direction of the hanging laces, kept opened during the day. All windows should be closed during the night and during rain. If the drying loft is rather long the installation of a large-blade ventilator may prove very helpful.

Coagulum and macerated crepe should never be stored in the factory but should be milled as early as possible and transference of milled laces to the drying loft should not be delayed. It has been observed on several occasions that the capacity of drying lofts is not sufficiently large to take the entire production during wet periods and that consequently coagulum and macerated blankets have been stored for 2 to 3 days. It is not to be wondered that crepe from such a coagulum is not up to standard. This state of affairs may be prevented by extending the existing drying space.

A delay in drying may also occur when the laces are not milled sufficiently thin.

If latex is standardized to a high d.r.c. the coagulum thus obtained will be hard and may cause difficulties during milling. Moreover, the coagulum will not be properly washed out and more non-rubber constituents will be retained in the coagulum, making conditions more favourable for mould growth and development of bacteria.

As a preventive measure against growth of microorganisms we would advise you to spray the entire loft including all the wooden constructions, the walls and the floor with a 1% solution of formalin (commercial liquid formalin is about 38%) and to disinfect periodically, say once or twice a week, all coagulating tanks, factory utensils and the factory floor with a 1% solution of a suitable disinfectant.

K. F. H.

Question:

I am using acetic acid as a coagulant for sheet manufacture. This acid is opalescent on dilution and the coagulum obtained by its use has a noticeably pale-grey discolouration and a mucilaginous appearance. The serum also has a greyish discolouration. Can you please advise me how to improve my sheet manufacture?

Answer:

There are three different ways of manufacturing acetic acid, namely: (1) fermentation or catalytical conversion of alcohol, (2) destructive distillation of wood at 570–750°F and (3) synthesis from calcium carbide.

Acetic acid obtained from destructive distillation of wood contains traces of phenolic substances from the wood tar, which are the cause for the opalescence on dilution. If such an acid is used for coagulation, the phenolic bodies may be oxidized by enzymes present in the latex and may cause the discolourations you have observed.

It may be emphasized that the Institute does not generally favour the use of acetic acid as a coagulant. The coagulating rate of acetic acid is rather slow and, under certain conditions, gives sufficient time for the latex to ferment, causing discolouration of the coagulum and bubble formation in the sheets. The underside of the coagulum has a mucilaginous appearance which is especially pronounced in pan coagulation and the smoked sheets may be found to be darker in colour. These defects may be prevented by using formic acid in place of acetic acid as the coagulant. It may be mentioned that formic acid also has antiseptic properties whereas acetic acid may stimulate bacterial development.

The quantity of formic acid required for coagulation is about 5–6 oz. of strong acid per 100 lb. of dry rubber. The acid should be added in the form of a 1% solution. For the preparation of a 1% solution 1 part of the acid should be diluted with 89 parts of water as commercial formic acid is only about 90% strength. It has been found on numerous occasions that the quality of sheets is considerably improved by changing from acetic acid to formic acid. As formic acid is only used at one half of the amount of acetic acid the costs of the coagulant will be much less at the present selling price of both these acids.

K. F. H.

The following papers which appeared in the Institute's Quarterly Journals were originally presented at the Natural Rubber Research Conference held in Kuala Lumpur, Malaya, in September 1960 and were published with the permission of the Programme Committee of the Conference:—

1. The Performance of R.R.I.C. Clones under Ceylon Conditions—by C. A. de Silva. *Rubb. Res. Inst. Ceylon Quart. J.* 1961, **37,** Part 1 p. 1.

2. Comparative Studies of the Chemical Composition of some Cover Plants—by A. J. Jeevaratnam. *Rubb. Res. Inst. Ceylon Quart. J.* 1961, **37,** Part 2, p. 33.

RUBBER RESEARCH BOARD

173rd Meeting:

Minutes of the 173rd meeting of the Rubber Research Board held at the Headquarters of the Planters' Association of Ceylon, 73/1, Kollupitiya Road, Colombo, at 2.30 p.m. on Monday 27th March, 1961.

Present.—Mr. T. C. A. de Soysa (in the Chair), Mr. N. Abeygoonewardene, Mr. W. P. H. Dias J.P., Senator L. Jayasundera, Mr. W. B. Jonklaas, Mr. B. Mahadeva (Rubber Controller), Mr. A. V. Richards (Director of Agriculture), Mr. C. R. Warren, Dr. E. D. C. Baptiste (Director) and Mr. C. D. de Fonseka (Chief Administrative Officer).

1. Minutes:

(*a*) *Confirmation.*—Draft minutes of the meeting held on 27th February 1961, which had been circulated to members, were signed by the Chairman subject to a minor amendment.

(*b*) *Matters arising from minutes:*

i. Kuruwita Sub-station.—It was reported that two members of the Board had visited the sub-station and that their report regarding the progress of work at the sub-station had been sent to the Chairman and the Director. Agreed that the report be circulated to Board members for their information.

It was noted that satisfactory progress had been made in clearing the 80 acres to be replanted this year and that the area would be ready for planting during the next S.W. Monsoon. The Director reported that he had inspected the seedlings available at the Karapincha Farm and had found them to be quite suitable for budding. The Director of Agriculture was thanked for having made the seedlings available.

It was agreed that with effect from 1962 the area to be replanted each year be limited to 40 acres.

ii. Joint Consultative Council.—The suggestion made by the R.R.I.C. Employees Union that a Joint Consultative Council be set up was approved.

iii. Visiting Agent.—Agreed that Mr. W. B. Jonklaas be appointed Visiting Agent of Dartonfield Group in succession to Mr. H. Creighton.

iv. Provident Fund Rules.—The amended Provident Fund Rules as drafted by the lawyers were adopted subject to the approval of the Commissioner of Labour and the Minister of Agriculture, Land, Irrigation & Power.

v. Gratuity to Mr. J. A. Nelson.—In view of Mr. J. A. Nelson's long association with the Rubber Research Institute of Ceylon, it was agreed that the Board should join the Malayan Rubber Fund Board in providing an *ex-gratia* payment to him on his retirement from the service of the London Advisory Committee.

2. Reports and Accounts:

(*a*) *Chairman's and Director's Reports for* 1960.—These were considered and the Director was complimented on his excellent report of work done during the year.

In view of the desirability of issuing the Director's report without delay it was decided that it be printed as "Annual Review for 1960". When the audited accounts are available they should be printed together with the Director's and Chairman's reports and forwarded to the Ministry.

(*b*) *Receipts and Payments Account for the 4th Quarter* 1960.—was approved.

(*c*) *Supplementary Votes.*—A supplementary vote of Rs. 4,010/- was passed to cover additional expenditure involved in the 1961 replanted area of 80 acres at Kuruwita sub-station.

3. Staff:

(*a*) *Director.*—Reported that Dr. E. D. C. Baptiste, Director, had returned from overseas leave and had assumed duties on 21st March, 1961.

(*b*) *Changes.*—Changes in staff since the last meeting were reported and approved.

(*c*) *Loans to officers for purchase of transport.*—Loans given to 3 officers for purchase of transport were reported and approved.

4. Next Meeting.—Agreed that the next meeting of the Board be held at 2.30 p.m. on 23rd May, 1961 and that a meeting of the Administrative Committee be held on 18th April, 1961 at 2.30 p.m.

5. Any Other Business:

(*a*) *Aerial Spraying for control of Phytophthora in South India.*—It was agreed that Dr. Riggenbach, Plant Pathologist, should go to South India for about a week to witness the aerial spraying of rubber with copper fungicides at low volume for the control of *Phytophthora.*

(*b*) *Botanist.*—It was reported that the contract of Mr. C. A. de Silva, Botanist, was due to terminate on 30th June and it was agreed that he should return to the service of the Institute, one month after the termination of the present contract, for a period of two years.

(*c*) *Co-ordinating Advisory Committee.*—Agreed that a representative of the Ceylon Government be included in the Co-ordinating Advisory Committee which had been set up for co-ordinating and advising the Malayan Rubber Fund Board on the programmes of research submitted by the Directors of the Rubber Research Institutes of Ceylon and Malaya.

It was also agreed that there should be a Ceylon representative on the Panel of Consultants which had replaced the Agricultural Sub-Committee of the London Advisory Committee.

(*d*) *International Rubber Research and Development Board.*—It was agreed that the Director should attend the meetings of the International Rubber Research and Development Board to be held in London from 5th to 8th June.

(*e*) *Mr. K. Wilson de Silva, Assistant Advisory Officer, Smallholdings Department.*—Agreed that Mr. Wilson de Silva should take his end of contract leave with effect from 1st June, 1961 and that he be re-engaged for a further period of 4 years and 3 months.

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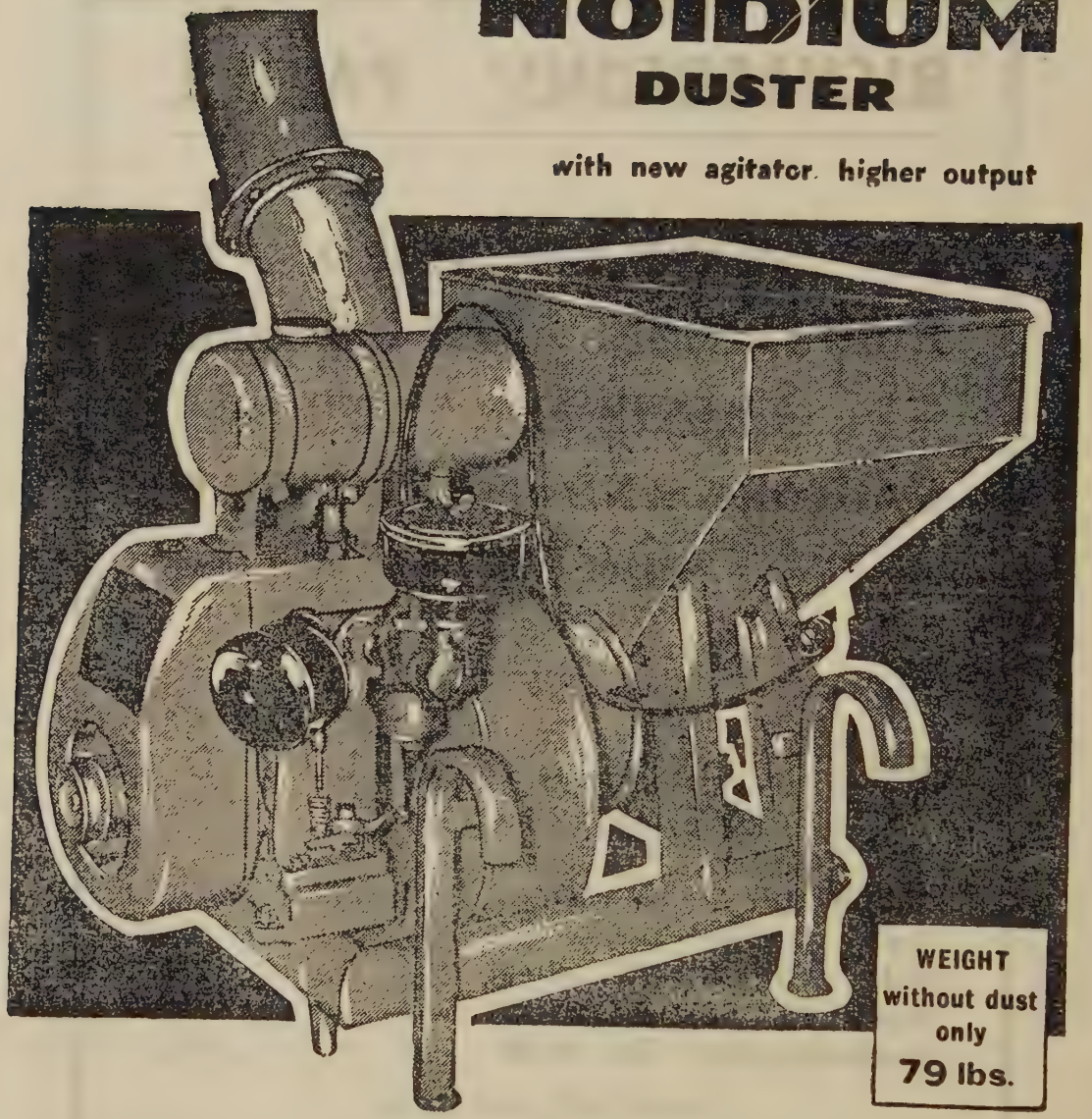

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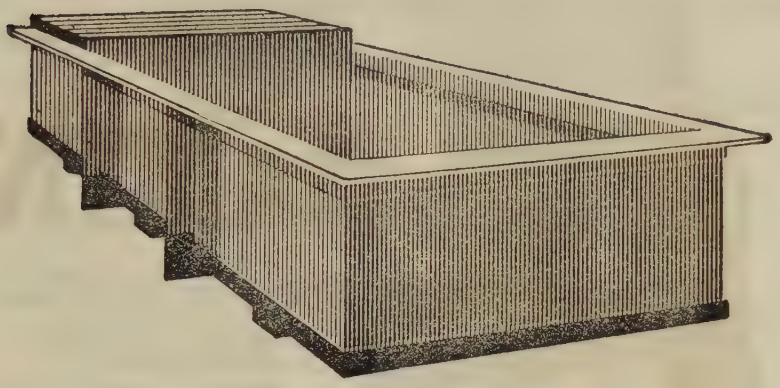

DCL All-Aluminium Coagulating Tanks are constructed to ensure years of trouble-free service. The shell is formed of one plate of pure aluminium and the reinforcing frame is fabricated from aluminium alloy sections.

DCL Coagulating Tanks ensure.

* Clean uniform sheets
* Substantial saving in time and labour costs
* Saving in equipment, no replacements of pans and other receptacles.
* The minimum percentage of froth sheets
* Saving in factory space

Tanks can be made to your requirements.
The standard capacity range is from 155 to 245 gallons.

Write to us for full particulars and prices

THE COLOMBO COMMERCIAL CO., LTD.

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CCC886

STAMINA

Stamina is vital to success on the sports field. It's stamina that makes you hold on tenaciously . . . . . persistent in attack . . . . stubborn in defence . . . . . and fighting fit to the very end.

So too in the field of protective painting . . . . in fighting rust, stamina counts. Atlas Ruskilla Iron and Steel Preservatives — The paints of stamina - withstand prolonged bad weather and exposure to the corrosive effects of steam, acid fumes and moisture.

Available in black, white, aluminium, and in a range of attractive colours Packed in 5-gallon drums, and one, half, and quarter gallon cans.

ATLAS
Ruskilla
The paints of Stamina

SHAW WALLACE & HEDGES LTD

P. O. Box 137,
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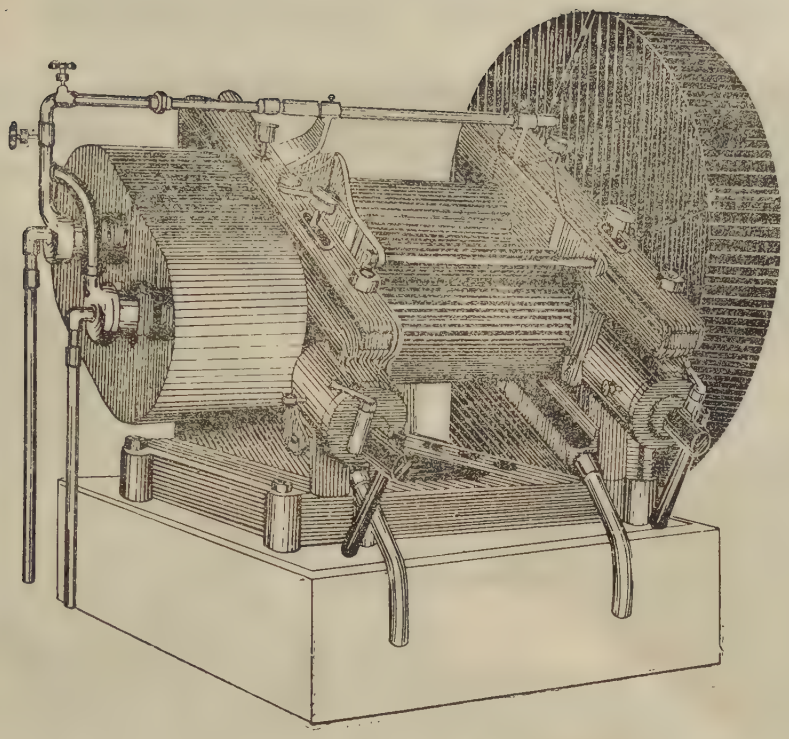

C C C 26" x 14" ANGLE TYPE RUBBER WASHING MILL

Low maintenance costs, permanently accurate alignment, and freedom from vibration during even the hardest rolls explain the permanent popularity of the CCC Rubber Washing Mill in Ceylon and Malaya. Over 300 of these machines are in daily use in these two largest rubber-producing countries.

Their immense strength ensures years of trouble free use.

Proved thoroughly efficient for

Macerating. Washing. Creping. Sheeting. Blanketing Sole-creping.

All rolls and driving gear are imported.

We supply any type of internally water-cooled rolls of close grain or chilled cast iron with smooth surface or grooved to any desired pattern.

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Shell Chemicals

SHELL

THE RINGTAIL POSSUM BUILDS ITS HOME

from twig and dry fern leaves.

But your building needs a roof of something stronger. ALCAN aluminium roofing sheet is light, strong, economical to transport and easy to erect. Once you use ALCAN, painting and maintenance problems are a thing of the past—for aluminium never rusts and lasts much longer than other materials. For further information about this modern roofing drop a line to:—

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ALCAN

Distributors in Ceylon for ALCAN and NORAL corrugated aluminium roofing sheet.

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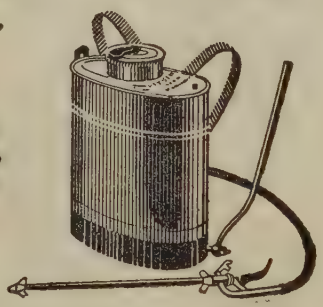
BRITISH MADE SPRAYERS

FOR TEA, PADDY & ALL CROPS, ANTI - MALARIAL & HOME INSECTICIDES EVERY SPRAYING REQUIREMENT

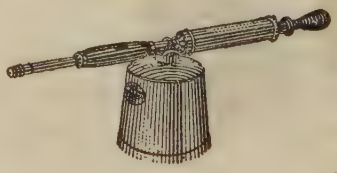
Thoroughly proved in Ceylon, and competitively priced, Mysto Sprayers are fine value for money.

Knapsack sprayer No. I: Manufactured of best quality brass sheet, the container is of 3¼ gallon capacity, and the machine weighs 15½ pounds complete.



The general purpose Mysto sprayer No. II: is capable of maintaining pressures of 100 lbs. per sq. in.; Minimum of pumping is necessary, and the handle can be used either right or left handed. Capacity 3¼ gallons.

Model 144 hand - sprayer: Manufactured of best quality brass. Container is seam-welded.



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W/SS Model - Stainless Steel Sprayer based on the exacting World Health Organisation specification. Working Capacity 2 gallons.

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Rs. 120/25 per 50 kilo keg.

Rs. 234/00 per 100 kilo keg.

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Rs. 34/00 per $\frac{1}{2}$ cwt. drum.

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Rs. 50/00 per cwt. drum.

Available ex stock.

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HARRISONS & CROSFIELD, LTD.

INCREASE YOUR
RUBBER YIELD
WITH THIS NEW
LATEX STIMULANT

"STIMULEX"

PATENT APPLIED FOR

- STIMULEX IS A NEW OIL BASE COMBINATION OF PLANT HORMONES, USED EXTENSIVELY IN MALAYA WHERE IT WAS PRODUCED AFTER 14 YEARS OF INTENSIVE RESEARCH.

- TWO APPLICATIONS OF "STIMULEX" PER ANNUM ON BARK OF RUBBER TREES, BELOW TAPPING CUT, CAN PROVIDE A LATEX YIELD INCREASE OF OVER 20% PER ANNUM.

- PLEASE ASK US FOR COMPLETE TECHNICAL DATA ON "STIMULEX" AND SEE HOW YOUR TREES CAN PRODUCE MORE LATEX AT NEGLIGIBLE COST.

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HUNTER & COMPANY LTD.

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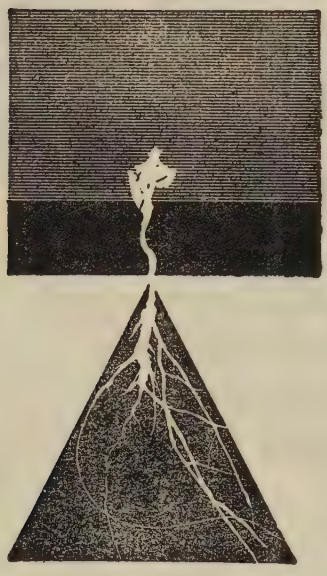

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prevents weeds in RUBBER

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Grasses as well as broadleaved weeds are controlled by Simazine 50W.

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NEW — increased power, reduced weight.

LIGHT — 88 lbs. (without handles)—amazingly portable.

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TROUBLE FREE — deals efficiently with lumpy sulphur.

designed for efficient and economical dusting

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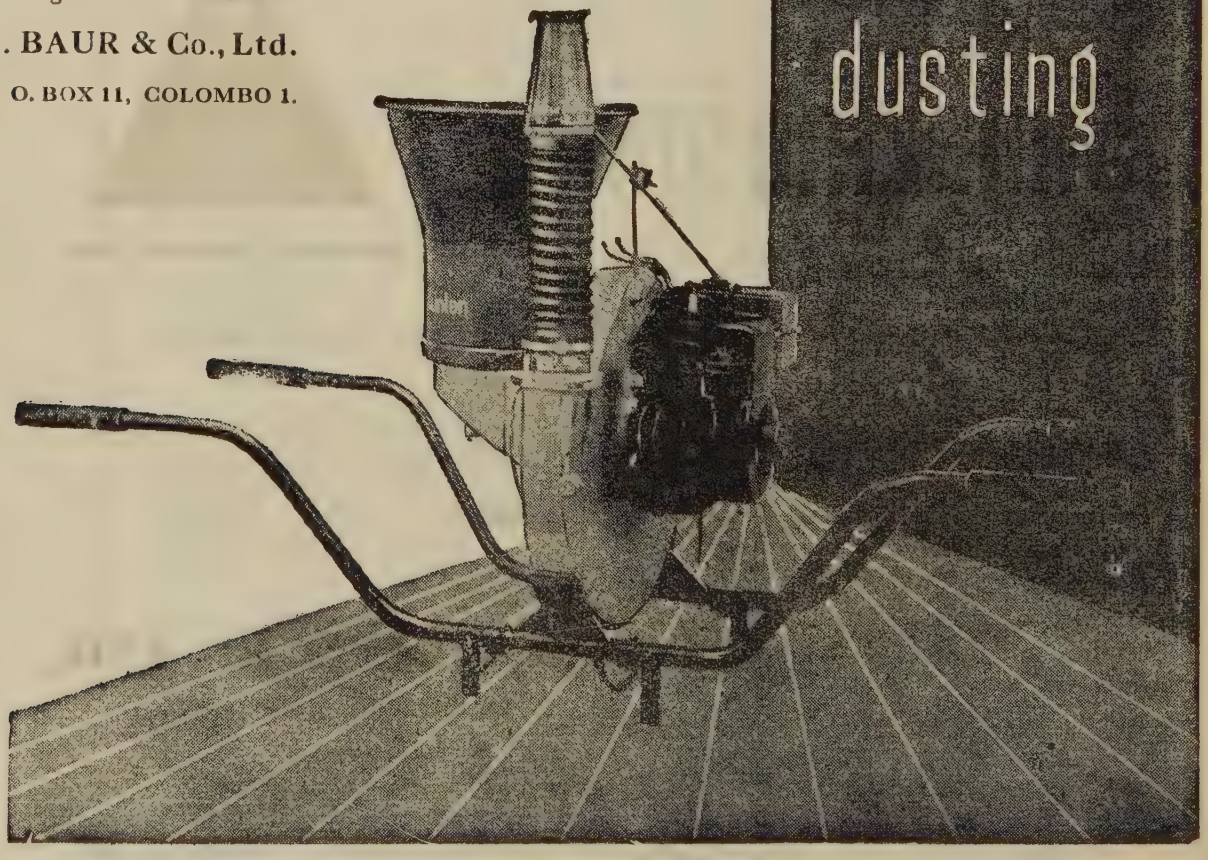

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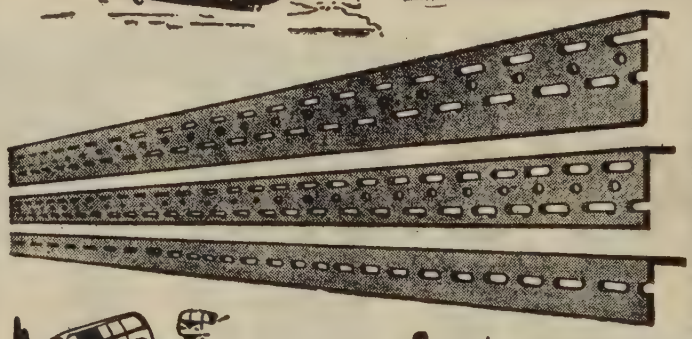

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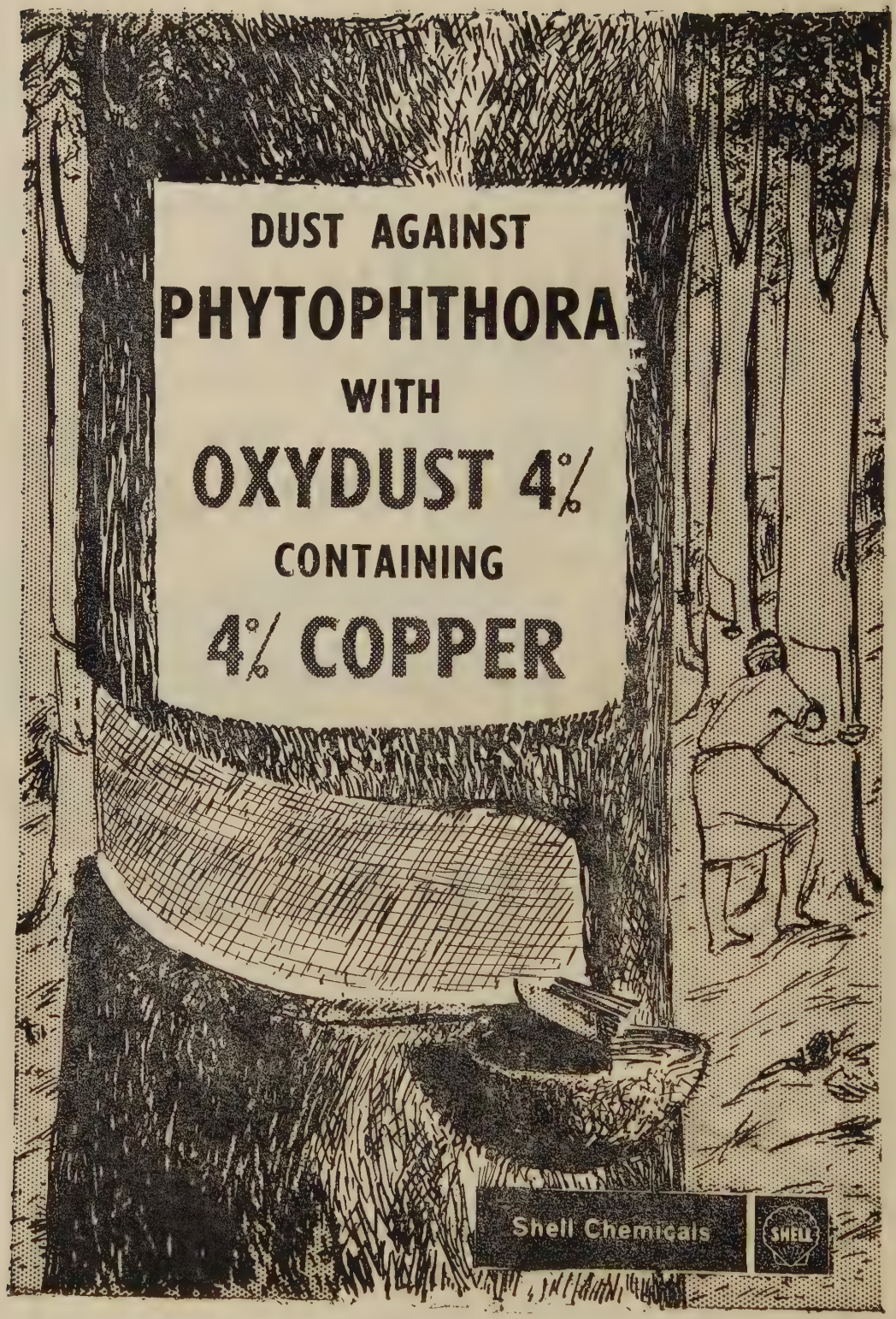
DUST AGAINST
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WITH
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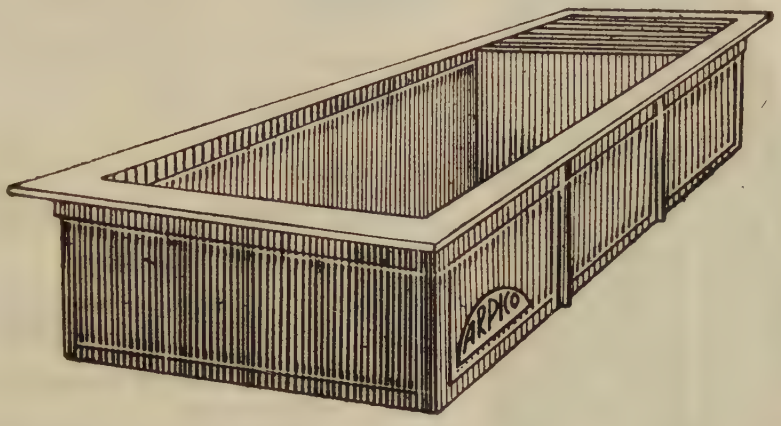
ALUMINIUM LATEX COAGULATING TANKS



These Aluminium Latex Coagulating Tanks, fabricated from Aluminium Alloy Sheets and Sections and Argon Arc Welded, are sturdily constructed to ensure years and years of trouble - free service.

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- **LABOUR SAVING**
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AVAILABLE IN 10′×3′×1½′ — 240 GALLONS CAPACITY.

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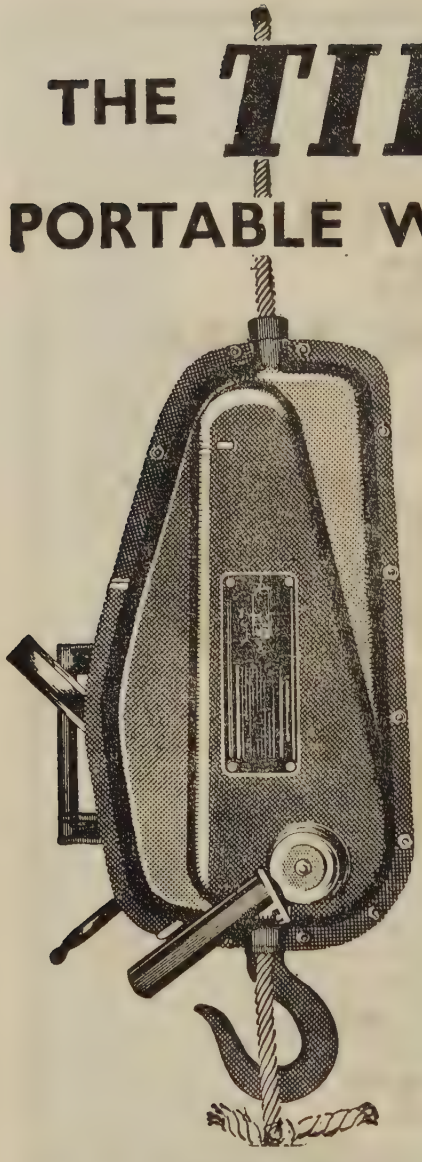

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